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VACCINE AND VACCINATION.[1]

By George Dock, M. D.,

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I intend to limit myself to a narrow part of the subject, and especially to the practical as distinguished from the scientific or theoretic side.

When we think of vaccination we must remember that if we are not wholly ignorant of the specific germs, we are still unable to make them serve as an index to the purity or quality of material, and we should also remember that we have no methods of dosage, such as make the application of diphtheria antitoxin and tuberculin fairly controllable. We recognize the effects of vaccine by the local results or by the immunity produced. For the former we have a more or less characteristic set of changes, ending in a peculiar and permanent scar. The immunity is not so easy to recognize in single cases, because we cannot tell how effective natural immunity might have been, and we rarely have more than the crudest notion of the degree of danger in a given case. When variolation was practiced the conditions were somewhat different, but with only casual exposure we are obliged to fall back, as proofs, on experiences with large numbers of people, where various degrees of thoroughness of vaccination and various degrees of danger of infection can be considered as neutralized by force of numbers.

[1] Read before the Johns Hopkins Hospital Medical Society, January 4, 1904.

The Material Used.

In the earliest days of vaccination the so-called lymph from vesicles on human beings was used. In Jenner's memorable experiment on James Phipps he used the virus from a cowpox vesicle on the hand of a dairy-maid, but later he inoculated from a vesicle on the nipple of a cow. After a few transfers this stock died out, as the former had done, but soon after the publication of Jenner's first work several new strains were obtained. Many of these were kept on by inoculating from arm to arm, or indirectly, and so were spread all over the world. It is interesting to remember that in America the virus was introduced by Waterhouse in Boston and Hosack in New York, the Southern States being early supplied by Waterhouse through the interest of President Jefferson. Some of the early vaccine was kept up for a long time. Drake tells us that he could see no change in course or phenomena in that used in the West in the forty-four years following its introduction in 1802. According to Kaposi, the

material in the Vienna Vaccine Institute was descended from some sent by Jenner to De Carro in 1802, and retained its efficiency in the late 80's. But it did not always keep so well. L. Pfeiffer mentions some that he saw a few years ago, of the same origin, so degenerated that it gave only a minimal areola and the scab dropped off on the 13th day.

Even in the first few years after Jenner's announcement the degeneration of virus was often observed, and the search for new cow-pox virus was made. It became more lively in the 20's, stimulated by the revival of small-pox in many countries, often affecting vaccinated persons. Partly from the incomplete protection thus shown, partly from the imperfect development of the vaccine lesions, it was believed that the material in use was not as potent as it had been in the beginning. But as a result of the lessened prevalence of small-pox, natural cow-pox was much less frequent than in Jenner's time. Rewards were offered in some countries for the discovery of cow-pox. Retro-vaccination, or the inoculation of the cow with human virus, was used for the purpose of reviving the stock. About the same time, that is in the end of the first third of the nineteenth century, the value of revaccination became known, though it took many years to be fairly appreciated, and it is still ignored in some parts of the world.

Experiments for the production of cow-pox, by inoculating animals with small-pox virus, had been made by some in the early part of the century, and these were repeated, and in the hands of Ceeley and especially of Badcock, of Brighton, were successful. Badcock himself vaccinated over 13,000 persons with the virus, and furnished material to many physicians and apothecaries. It is an interesting fact that Dr. W. E. Coale, of Boston, "suspecting the efficiency of the virus then in use," obtained some of Badcock's material. In 1852, Badcock sent him some "crusts from a variolated cow, a glass charged with the same material, and some points charged from a vesicle on a child's arm," caused by some of the primary lymph. Badcock sent Dr. Coale some more material in 1855, though this was not direct from the cow. Drs. Adams, of Waltham, and Putnam, of Boston, repeated Ceeley's experiments successfully, according to a letter by Dr. Coale, dated April 6, 1852, in the *Boston Daily Advertiser*. Other experiments made from the time of Badcock down to a recent period, by various investigators, have demonstrated the possibility of obtaining vaccine virus by variolating cows, and although the results were opposed by Chauveau and his colleagues, their scientific and economic value is now universally recognized, while the occasional propagation of small-pox by vaccination from such animals is explained by obvious errors in technic.

But the great bulk of material used for vaccinating, down to the 70's, was humanized virus, inoculated either from arm to arm or indirectly. In large cities it was not difficult to keep up the succession, though the chief localities for that, foundling asylums, had certain important disadvantages. In the country and in small towns the supply often failed, or gave poor results. The methods used for keeping and inoculating vaccine in this period, other than by operating from arm to arm, are of some interest.

One of the earliest methods of preservation was by drying the lymph, obtained by puncturing a vesicle, on a piece of glass. This was tied together with another glass and the two kept dry until wanted. Another was to soak threads in the virus, dry them and keep them in bottles. Or the virus was dried on elongated glass stoppers and the stoppers fixed in bottles, or it was dried on lancets, quills, or even thorns. On account of the rusting of steel instruments, with damage to the latter if not to the virus, silver or gilt lancets were used. Needles were used sometimes, and a Dr. Carl, in Prague, invented a forked silver needle. Small glass tubes, such as barometer tubes, were also used, sealed at the ends by fusing. The use of crusts or scabs came comparatively late.

The Early Technic.

There were many modifications of the method of inoculating, though the details were for the most part derived from the earlier small-pox inoculations. Jenner first used short incisions, or punctures. When threads were used, they were cut in short lengths, placed in shallow incisions, and kept there by adhesive plaster. From the fact that some operators renewed the threads on the third day we may assume that the method was not always successful. Sometimes the dried material, on threads, glass or instruments, was softened by soaking in blood, or by exposing to the vapor of boiling water, or soaking in water, or even saliva. More complicated methods of getting an inoculating surface were sometimes followed. Cross-scratching seems to have been a later invention. Fly-blisters were used at an early period, even a skin-trepan was invented, and as late as 1902 a cautery-hammer was devised, for raising a blister, in the cavity of which vaccine was to be inoculated. At various times since the invention of the hypodermic syringe, that instrument has been used for injecting vaccine virus into the skin or subcutaneous tissue. Although it seems to serve the purpose, it has no great advantage, and some disadvantages.

One of the common details of vaccinating developed from the use of humanized virus, viz., the practice of making multiple lesions. It was thought that the taking of part of the lymph lessened the effect on the vaccinifer, and so several vesicles were produced, one at least being untouched. Although the protection afforded by one good vesicle has always been recognized, there is some reason for believing that protection is in proportion to the area of typical scar.

Bovine Virus.

The growing realization of the inconveniences of humanized virus gradually led to the development of another method, but there were other reasons besides the technical ones. In the 60's the fear of transmitting syphilis by vaccination became intensified, and although investigation showed that the risk was slight, considering the large number of people vaccinated, it also proved that the danger was real.

The possibility of transmitting tuberculosis was also suggested by the work of Villemin, and was for a time much exaggerated. So attention was directed more and more to the use of bovine virus, that is, material raised purposely on the animal. In this way it was thought that the danger of setting up syphilis and tuberculosis could be avoided, and although the fear of transmitting inflammatory diseases was not absent, it did not retard the movement. In fact, then as now, there were some who thought that severe local reactions were desirable.

The use of bovine vaccine goes back directly to Negri, who cultivated virus on animals, in Naples, from 1842. It is said that the same method was begun in Naples early in the century, but prohibited by law. Negri's method and material were introduced in Paris in 1864, by Lanoix, who, however, adopted cow-pox virus from the celebrated spontaneous case discovered at Beaugency, France, in 1866. The method spread rapidly. It was introduced in Brussels in 1865, by Warlomont, and in Berlin, in the same year, by Pissin, and soon afterwards in Vienna. In 1870, Dr. Henry A. Martin, of Boston, an indefatigable investigator and cultivator of vaccine, imported some of the Paris material, just before the strain died out during the siege. For some time after bovine virus came into use, the method of preservation was chiefly that of coating ivory slips with virus obtained by puncturing vesicles, the bases of which were compressed by forceps. Scabs were also used. On the continent of Europe a popular method consisted in vaccinating directly from the calf, the animal being taken to the domicile or to a central location, as was most convenient.

THE USE OF PULP.

At first the material used was the liquid part of the contents of the vesicle, as was necessarily the case in using human virus before the scab stage, but in the 80's the so-called pulp came into use. The reason for the change was complex, and had reference partly to the greater tenacity of the liquid part of the bovine vesicle as compared with that of the human one, and its greater tendency to coagulate. The pulp is the whole vesicle, made up of the cells of the skin in the lesion, leucocytes, red-blood corpuscles, fibrin, fat, specific and non-specific micro-organisms, and debris. Many objections have been made to the use of pulp vaccine, and from time to time these are brought forward in articles, but the arguments advanced are misleading, to say the least. Thus, it is said that pulp contains more pus and more bacteria than the liquid part obtained either by puncture of the vesicle or by tearing off the top of the vesicle and permitting liquid to exude from the base. But at the time the pulp is taken there is no pus in the ordinary sense, and it has never been demonstrated that the whole pulp contains more bacteria, bulk for bulk, than does the liquid part. Careful observations are needed in this connection, but at the present time it should be borne in mind that the best vaccine in every respect, that is, the virus that causes least accidental infections and gives the best protection, is pulp vaccine. By this I mean the virus used over most of Western Europe and in England, and notably in Germany, where the statistics on all the points concerned are most complete.

Many methods of treating the pulp have been experimented with. It is not necessary for my purpose to discuss these, and I shall consider only the method now almost universally used, describing it in some detail from the beginning.

Calves are used, generally from 3 to 6 months old, sometimes younger or older. Females are usually preferred on account of the greater cleanliness of bedding, though some operators use young bulls, which they inoculate on the scrotum. The animals are examined with reference to soundness, and are sometimes tested with tuberculin, though this is not necessary, as they are usually killed soon after the operation and can then be examined for disease, before the vaccine is distributed. After being under observation a few days the calves are thoroughly cleaned. Just before the operation, the animal selected having been fastened on a suitable table, the abdomen is shaved and washed with soap and warm water. In some institutions sublimate, carbolic acid or other antiseptic is used. A final washing is done with large quantities of sterlized water and the skin dried with sterilized towels. The operators, in sterilized clothing, observe the usual aseptic precautions. A series of incisions is made in the skin of the abdomen, about an inch apart, extending as far forwards as the navel and laterally to the inner sides of the thighs. Sometimes the anterior abdomen, and even the side and back of the body have been used, but the thicker skin in these parts interferes with the best results. If more than slight bleeding follows the incisions it is checked by pressure with sterilized towels. The "seed" vaccine is then spread over the prepared surface with a spatula and allowed to dry. The seed is of various kinds. Sometimes it is bovine virus, selected with care from well-developed vesicles and of tested bacterial purity. Sometimes it is selected humanized vaccine, sometimes material derived more or less remotely from human variola. Often the makers either do not know, or are unwilling to state, the source and nature of the seed, and often misrepresentation has occurred. It is clear that in order to make an accurate study of the effects of vaccination the history of the material used is essential.

Dressings of various kinds have been used to protect the site of operation, but usually they are not considered necessary. The animals are kept in clean stalls, and carefully observed until the time for removal of the material, between the fourth and sixth days. The vesicles are then of fairly good size, but should not show evidences of suppuration. The calf is again fastened on the table, the abdomen thoroughly scrubbed with soap and warm water, rubbed by hand, and finally washed with sterilized water and dried. This removes the superficial dried epidermic scabs, and does not break the vesicles. For the removal of the pulp the common method is to scrape each row of vesicles with a large curette, though it is said that some still use the forceps to clamp the bases. The

pulp is then made homogeneous by grinding, mixed with 50 per cent glycerine, and kept for several weeks to "ripen."

Up to the early 80's pulp was used according to the earlier methods, but after that great activity was displayed in treating pulp with various antiseptics, the details reminding one of the complicated antiseptic dressings used in general surgery at the same period, but since 1891 the use of glycerinated lymph has been general. The addition of glycerine to vaccine virus is much older. Cheyne employed it as early as 1850 to keep lymph fluid; Mueller in 1866 to increase the bulk; Warlomont patented a method in 1882, and there are dozens of references to its use before him. But Copeman, by a series of careful investigations, showed that glycerinated pulp lost some of the bacteria it originally contained, and that they might even disappear completely at a time when the specific virus was still unimpaired in strength, and since then the method has been adopted by the leading vaccine institutions with little or no modification. Drying the pulp or lymph has a similar action on the bacteria, but glycerine has other advantages, one of the most important being the facility with which tests can be made on the glycerinated pulp, rendered fairly uniform by mixing in special apparatus.

The tenacity of life of the specific germs has long been known to vary much, even under conditions apparently similar. In the glycerine preparations this is also true, but the real state is easy to fix by experiment in any specimen. It has been shown that glycerinated vaccine may be effective as long as a year after removal. Though the usual dilution is slight, from half to several times the weight of pulp being added in 50 per cent sterilized glycerine, dilutions of 1 to 2000 will give good results if carefully used. By the present method one calf will furnish from several hundred to several thousand portions of vaccine, three to four thousand being not unusual, and perfect vaccination has been obtained from calves giving as much as 15,000 portions.

Copeman has summarized the advantages of glycerinated vaccine, and I quote from him the following:

"1. Great increase in quantity can be obtained without any consequent deterioration in quality, the percentage of insertion success following on its use being equal to that obtained with perfectly active fresh lymph.

"2. It does not dry up rapidly, as does unglycerinated lymph, thus simplifying the process of vaccination.

"3. It does not coagulate, so that it never becomes necessary to discard a tube on this account.

"4. It can be produced absolutely free from the various streptococci and staphylococci which are usually to be found in untreated calf lymph, and which are, under certain circumstances, liable to occasion suppuration.

"5. The streptococcus of erysipelas is rapidly killed out by the germicidal action of the glycerine. The danger of 'late' erysipelas is diminished by reason of there being no necessity to open the mature vesicle for the purpose of obtaining lymph.

"6. The bacteriological purity and clinical activity of large quantities of the lymph can be readily tested prior to distribution."

But no one who knows the subject claims perfection for glycerinated virus. Many efforts to improve on it have been made, by using other germicides, and many more will doubtless be made, until something still more satisfactory can be discovered. In the meantime it is necessary for all who have to use vaccine to know just what can be expected with the present methods.

The Vaccine Lesions.

Let us now examine some of the peculiarities of the vaccine lesions. From the beginning it has been recognized that the vaccine pock presents peculiarities by which it can be distinguished from all other skin lesions, and especially from smallpox, varioloid and chicken-pox; and by which one can form some opinion as to the quality of the change produced in the organism by vaccination. In his first publication, Jenner gave some pictures that have always been accepted as of the greatest value. All of Jenner's contemporaries admitted the fidelity of the illustrations, and Cuff, who colored them, and who made others for later writers, insisted on their accuracy after he had seen many hundreds of lesions. I show lantern slides of these plates, viz.: The original cow-pox vesicle on the hand of Sarah Nelmes; a vesicle, the second remove from horse-pox; a vesicle in a late stage, the second remove from a vesicle on a cow, casually derived from horse-pox; a vesicle on the 9th day, from virus taken from the subject of the preceding. While these figures are very instructive, Jenner was justly criticised because he did not give a complete description, with illustrations, of the whole course of the disease. He made good the deficiency in 1801, when he published a set of illustrations by Cuff, which I also show. In the meantime Aikin, in England, and Ballhorn and Stromeyer, in Germany, had published illustrations, and these were followed by many others more or less perfectly executed. Waterhouse had an illustration made showing the appearance of the vesicle in the negro, an important aid in the development of vaccination in America.

I show next a copy of Sacco's illustration of cow-pox on the udder of a cow (after Rayer). Pfeiffer is probably right in thinking this was an inoculated cow-pox, not spontaneous, this belief being based on the distribution of the lesions. The vesicles are larger than those in trade vaccination. The next slides, Rayer's own pictures of the vaccine vesicle, are also of interest, on account of the general accuracy of Rayer's illustrations of skin lesions, and the influence the writer exerted upon medicine. I show also his pictures of atypical vaccination. Not less interesting are John D. Fisher's pictures, taken as they were from what were considered typical vesicles by men who remembered the earliest days of vaccination. The next series is that of Kirtland, made in 1802, and interesting because it shows the course of inoculated variola with that of vaccination at corresponding dates, but as it was not published until 1896 it did not affect the development of vaccination. Another valuable picture, historically, is that of Bousquet, showing the effects of recent virus from the cow-pox case of

1836, at Passy, compared with the old virus then used in Paris.

Variations in the details and course of the vesicle have always been recognized as likely to occur, even with perfectly good virus, but on the other hand, marked departures in size, shape and course have always been considered as throwing the gravest doubt on the quality and also on the consequent immunity. Jenner insisted on the necessity of repeating vaccination until a perfect result was obtained. Recently, some doubt has been thrown on the essential nature of the areola, especially by makers of vaccine, and it might readily be supposed that this will not form after the use of virus of great bacterial purity. But I do not think we can abandon even this part of the local phenomena of vaccinia. In countries where most pains are taken to get good vaccine, and where its results are carefully followed and recorded, the areola is usually well-developed. I show some slides taken from cases inoculated by myself with American glycerinated virus of fair bacterial purity, but rather weak specific power, with well-developed areolæ. Incidentally, let me call attention to the method of inoculation, by single incisions, of which I shall speak later. The next and last picture I consider of great importance. It is from a photograph, and shows two lesions. These have dark roundish scabs with irregular surfaces, measuring 6 by 8 and 7 by 8 mm. respectively. Around each scab is a ring-shaped vesicle, from 1½ to 3 mm. wide. There is no distinct areola, but an unusally deep-looking narrow zone of redness and swelling, very unsymmetrically placed, strongly suggesting local infection. This photograph has been widely reproduced in advertisements as a representation of typical vaccine lesions. It differs radically from anything hitherto accepted as a typical lesion, and I shall have to speak of it later. It may serve to introduce the next division of my subject.

Some Aspects of American Vaccine Virus.

I must say at the outset that I do not intend to speak of all makes or makers of vaccine in the United States, but only of certain characteristics that I have found among a few rather conspicuous firms.

It might be supposed that makers of vaccine virus would not sell inferior preparations. Experience shows that this is not so. Dr. Rosenau, of the U. S. Public Health and Marine Hospital Service, who has examined virus for a long period, has shown that practically all the vaccine virus sold in this country has an unnecessarily large bacterial contamination, and although his observations show that improvements have taken place since he began his work, the results are still far from satisfactory. Rosenau charitably attributes the poor quality of the vaccine in part to over-confidence in the germicidal power of glycerine on the part of the makers. This, however, while charitable, is not altogether just. The makers had access to the literature, from which the actual capacity of glycerine to purify vaccine could have been obtained. Besides, the makers, particularly those I have in mind, made the most positive statements of purity, not only in advertisements, where such words as "aseptic" might have had a Pickwickian sense, but also in private correspondence, at the very time the virus, according to Rosenau's examinations, was very bad. It must be remembered that high bacterial contamination does not necessarily indicate dangerous infective possibility, but on the other hand it is believed by many that such an excess has a relation with the frequent secondary infections that occur from such virus. Then, too, the remarkable development of tetanus following vaccination, of two years ago, has been ascribed by MacFarland, long connected with the production of vaccine, partly at least to contaminated virus. Another explanation for the impurity of the virus is that sudden calls for large quantities compel the makers to put on the market "unripe" vaccine. In the present unregulated state of vaccination such demands are unavoidable. Systematic vaccination would do away with it. As it is now it would seem that policy, if not honesty, would lead the makers to declare the imperfection of the virus, just as some honest boards of health, unable to furnish pure water to cities, notify citizens when the contamination reaches a dangerous degree. Or, to take a more commercial comparison, large demand does not excuse a butcher who for a similar reason sells spoiled meat.

The purity of American vaccine is not always as perfect as it should be; how is it about the specific power, or the capacity to confer immunity against small-pox? Much of it is seriously lacking in specific power. Some makers not only admit, but advertise as a point of excellence, that their vaccine does not produce an eruption. While they do not state in advertisements that scars are not left, I have heard the scientific manager of one large firm assert before a medical society that a scar is not necessary. Not only is there no proof of this, but, on the contrary, all the evidence we have goes to show that a certain scar, not too large, not too deep, and quite different from the scar following a slough or a phlegmon, is an essential part of the result of efficient vaccination. Another manager admitted to me that his firm aimed at getting the mildest possible result from vaccination. This they did, as my observations show, by reducing the specific action, for bacterial contamination was quite marked in many points and tubes I saw in use.

Weak specific action has an important bearing on the practical use of vaccination. With the best vaccine we expect to produce immunity lasting for several years, if not, as was once hoped, for a lifetime. Though small-pox, even fatal small-pox, may occur in some persons so vaccinated, yet the general resistance will be high. With less effective virus the immunity is shorter, from a few weeks to a few months, and on the whole very imperfect. At first glance it may seem that vaccine giving protection for even a month would be good enough, but more careful examination seriously alters the matter. If for no other reason, the production of a wound every few weeks would be not only dangerous, but would be more intolerable than the fear of small-pox itself. Moreover, vaccine that gives an abortive vesicle, indicating short duration of immunity, is often very slow in taking, up

to a month in one make, by the admission of one of the managers of the firm. But such vaccine would be useless in the face of actual danger, as has occurred so often in the last five years, and as is likely to occur, suddenly, many times in future before our laws are perfected.

Along with indifference to the production of pure and efficient vaccine, some of the makers of that material exert a positive influence for harm as extensive as it is insidious. In the advertising pages of scores of journals, and in countless circulars, not only are the advantages of the wares set forth in the usual language of advertisements, but questions of technic, of pathology and treatment are stated with impressive assurance. The photograph I showed illustrates some of these features. It is said to have been taken on the 8th day, but instead of showing the smooth umbilicated vesicle characteristic of that time, it shows a poorly developed vesicle surrounding a large dense scab. This is not the scab from drying of the contents of the vesicle, but is the result of necrosis of the skin, caused by extensive and deep scraping, part of the technic recommended by the firm. This method, if not original with makers of vaccine, owes its present vogue, I think, to the writings and pictures published by such firms, and to the demonstrations made by representatives of the firms, sometimes men of no medical training whatever. It is based upon a method formerly much used by physicians, and still recommended in some text-books, but according to the original method the denudation is very superficial, the epidermis is regenerated within a few hours, and the vaccine lesion goes on undisturbed by a necrotic mass over its place of inoculation. But the early scab is undesirable for other reasons than the very good one just mentioned. It favors accidental infection by rubbing with the nails or clothing, owing to its irritating qualities; it furnishes a good nidus for germs either originally in the skin, or introduced at the operation or later, and especially for those of tetanus. Many vaccine wounds have been so severe that boards of health have found it necessary to protest against them, and the Board of Health of Chicago has taken the pains to print a diagram one-eighth inch square as the largest abrasion compatible with safety. It would be much better to prohibit such an operation entirely, as has been the law in Germany for several years. As my own photographs show, clean superficial incisions will permit the virus to take, if it is potent, and it is obvious that if such incisions do not heal by primary union, there is at least but little irritating and septic material in them.

The history of the photograph with the hard scab also illustrates other aspects of the vaccine trade, viz., the possibility of lack of special knowledge of vaccinia on the part of the makers, and the differences of interest of the so-called biologic department and the counting-room. The gentleman in charge of the former was not aware of the difference between a depression caused by an early scab, and the characteristic umbilication of the genuine vesicle. In a letter replying to my criticism of the picture he wrote: "I saw these vaccinations just before they were photographed, and, in my opinion, they are very nearly typical for the age of the lesions." He also asserted that his firm had never sent out any other pictures of vaccine lesions, and quoted employees of the publication department to prove the statement, though I was able to show him a picture sent out as a circular by his firm, in which a group of abortive conoidal vesicles was reproduced as an illustration of the successful use of the virus.

I mention this experience as an evidence of the need of some better arrangements for the production of vaccine virus than we now possess, an arrangement by which the material would become less a commodity to be turned out according to the inclinations of those who know nothing and care little for any other than its selling qualities, and more the subject of careful elaboration and well-directed effort at improvement. Copeman makes the interesting statement that in the vaccine institutions he visited in Europe researches were being made tending to improve the quality of vaccine. Medical literature bears witness to the scientific activity of these institutions, but in this country the only originality exhibited is limited to details of packing.

It is too often forgotten that vaccination is a public rather than a private benefit. Its real object is not merely to prevent sickness or death in individuals, but to prevent epidemics with all their numerous and widespread consequences. This is the reason why some countries have adopted general vaccination, and the reason why in this country, without a well-planned regulation, measures are adopted in times of danger that aim at compulsory and general vaccination, but for various reasons often fail.

If people voluntarily adopt general vaccination, they are not likely to continue the practice unless the operation is reasonably mild and safe, and the protection fairly certain. As more or less compulsory vaccination is likely to be necessary for a long time to come, it would seem essential that the power compelling the operation should guarantee the purity of material and the safety of the operation.

For this, either public manufacture or public inspection are necessary. Inspection as carried out for the last two years under the Public Health and Marine Hospital Service has done some good, but as the results are published without names much of the value of the examinations is lost, and no test of specific activity is attempted. It is often said that such control is impossible under our system of government, but this objection is more theoretical than real. If the general government can furnish pure seed to farmers, and the separate States regulate the sale of oleomargarine, the inspection of oil, salt, etc., or the sale of alcoholics and tobacco, vaccine could easily be put under public control, provided, of course, that the wishes of the people were not thwarted by the unseen but powerful influence of lobbies supported by those who prefer to keep the industry in their own hands. The details of such public control are beyond the scope of this paper, which aims rather at exciting an interest in the practice of vaccination and its accurate and careful study.

CONCERNING THE SINUS FRONTALES IN MAN WITH OBSERVATIONS UPON THEM IN SOME OTHER MAMMALIAN SKULLS.

By Adelbert Watts Lee, M. D.

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(*From the Hearst Anatomical Laboratory of the University of California.*)

A review of the literature suggests the necessity of a more complete description of the sinus frontales with some revision of the nomenclature according to their developmental characteristics, as well as a complete study of their architecture. The writer accordingly took Dr. Flint's suggestion to make a series of metallic injections of these cavities in order to reveal in positive form the normal negative outlines of the sinuses. Since students rarely obtain a stereoscopic concept of the pneumatic spaces contributing so markedly to the shape of the human cranium, an employment of the method by classes engaged in routine dissections is urged. In this laboratory it is found that students gain a much clearer idea of the cavities when they are studied by means of lead casts.

As will be seen by reference to the illustrations, two kinds of technique were utilized in gathering data for this paper, namely, chiselling and casting. The chisel calls for time and some delicacy of manipulation to get good results, but casting is simple, rapid, and seems by far the best method, inasmuch as the lead mold positively expresses the negative sinus. Following is an outline of the casting method:

When students have completed the dissections of the external face and cranium, a sagittal section of the head is made corresponding to the median line. While one or the other sinus frequently overlaps the median plane, the septum between them is commonly complete; accordingly it occasionally happens that the sections open only one sinus, and a pour-hole into the other must be provided by drilling through the intact septum. To prevent the metal escaping from the sinus by way of the infundibulum ethmoidale, the hiatus semilunaris is exposed and plugged with moist clay. In a melting pot over a circular gas burner, lead is raised to a temperature of brisk oxidation, as metal of a lower temperature often solidifies before reaching the utmost limits of the cavity. With these precautions the metal is directed into the sinus with a pouring ladle. It must, however, be poured slowly and in a thin stream, for should it enter rapidly and in a large mass, air is often retained in the sinus in quantities sufficient to ruin the cast. After allowing the lead to cool thoroughly the material is returned to the student for further dissection. Under the supervision of an instructor, he carefully removes the molds. They are then marked with the body number, making it possible at any time to obtain collateral information concerning the individual by consulting the records in the preparation room. The casts have rough surfaces due to generation of gas by the melted lead coming in contact with organic tissue in the cavities. Furthermore, the metal contracts slightly while cooling, but in the main the molds approximate quite exactly the sinuses in which they are made.

This study is based upon examination of twenty-one adult male subjects, in age ranging from twenty-five to sixty years. The molds of all the sinuses changed from their normal state by pathological processes were rejected.

The cavities are said to be generally smaller in the female than in the male. Owen[1] has observed that the sinuses of Europeans are larger than in some other tribes. He states that they are imperfectly developed among the native Australians, and in consequence this deficiency engenders a want of resonance to the voice. In opposition to this, Macalister states that the sinuses are very large in Australian crania,[2] and Hilton finds them quite extensive in the skull of an African aborigine.[3] The latter, however, made but a single observation, and it is possible, of course, that his specimen might have been an unusual one.

Sufficient attention has not been called either to the importance of symmetry in the architecture of living forms, to its significance, or to the means by which it becomes one of the most striking characteristics of all the higher forms of organic life. It is suggestive, however, that all structures in the body are at some period in the life-history of the organism either completely or partially symmetrical—that is to say, form either complete mirror changes of each other, or may be divided by a median plane into halves which are enantiomorphic. In this connection it is noteworthy, therefore, that the sinus frontales vary in respect to symmetry more than any other paired structures in the human body. This is noted not only with reference to the deflection of the septum sinuum frontalium but also in other characteristics of sinuses in the same skull.

The sinuses form two cavities in the os frontale, situated dorsad of the arcus superciliaris and cephalad of the orbita, displacing the spongy bone between the inner and outer tables. They communicate with the meatus nasi medius by means of an osseous tube, the infundibulum ethmoidale, and are lined with a continuation of the nasal mucous membrane. Their

[1] Owen, Ours: Circle of Sciences, p. 167. Quoted by Humphry. A Treatise on the Human Skeleton, etc. G. M. Humphry. Macmillan & Co., London, 1858.

[2] A Text Book of Human Anatomy, etc. A. Macalister. P. Blakiston Son & Co.

[3] Hilton On the Cranium, p. 13. Quoted by Humphrey. A Treatise on the Human Skeleton, etc. G. M. Humphry. Macmillan & Co., London, 1858.

position divides them into two parts, the pars frontalis, the portion of the sinus in the squama, and the pars orbitalis, the portion in the pars orbitalis ossis frontalis. Both frontal parts are shown in Fig. 5, *P. F. D.* and *P. F. S.* The orbital parts are shown in the same figure, *P. O. D.* and *P. O. S.* Between the partes frontales is a perforate or imperforate partition of bone, leaning to one side or the other, the septum sinuum frontalium (Fig. 5, *s. s. f.*). The frontal and orbital parts of the cavity are separated from each other in varying degrees by a partition of bone called the septum interpartes (Fig. 5, *s. i. d.*). The cavities are also subdivided by bony trabeculæ called septa laterales when in the pars frontalis (Fig. 5, *s. l. s.*), and septa dorsales when in the pars orbitalis (Fig. 5, *s. d. s.*). The lateral limits of the sinuses are ordinarily distant from each other about seven centimeters. They reach cephalad into the squama about three centimeters, and the diameter of a sinus from the most ventral point of the pars frontalis to the most dorsal one of the pars orbitalis is about two and a half centimeters. These figures of course represent the average of the twenty-one specimens used for this study. The pars frontalis of one sinus usually overlaps the median line and encroaches upon the territory of the other. This unequal development is responsible for the deflection of the septum sinuum frontalium. The two cavities always show a marked difference in outline and capacity, as is readily seen upon inspection of the casts represented in Fig. 5.

The sinus frontalis may be absent throughout life. This condition was found once in the skull of an old adult and the usual superciliary eminences were entirely wanting of both sides.[4] The extremes in size are pictured in Figs. 3 and 4, the former showing the largest, the latter the smallest casts in the series.

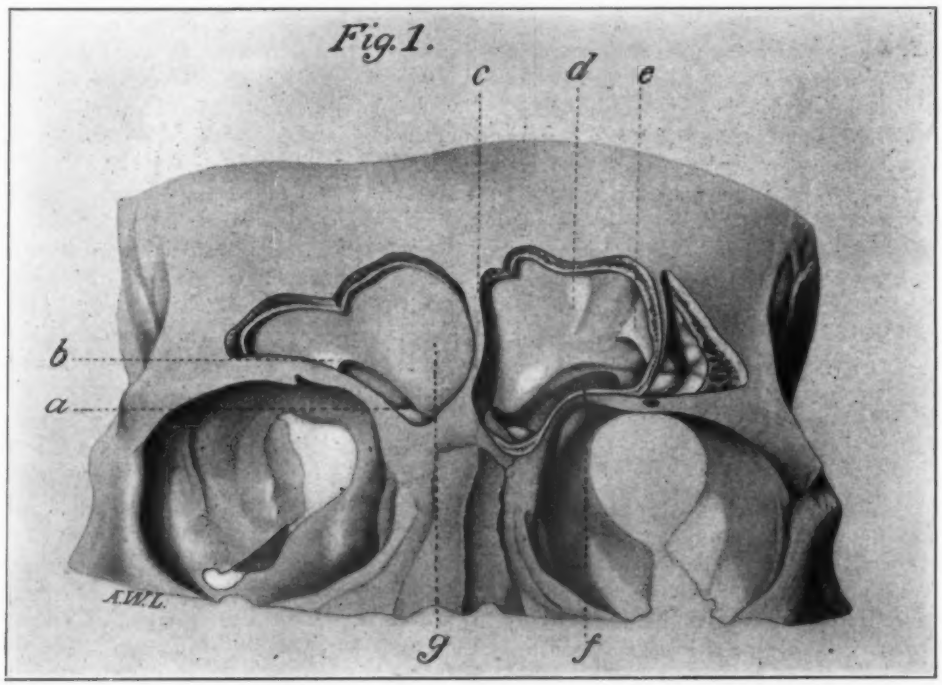

FIGURE 1.—Human Sinus Frontalis. In this case the arcus superciliaris on each side was equally developed, notwithstanding the difference in the size of the sinuses. The median septum approximates the mid-line more clearly than is usually the case.

a—Summit of Bulla ethmoidalis dextra. Its fellow is opposite occupying a slightly lower level.

b—Septum interpartes.

c—A strip of the outer table of the skull and a portion of diploë above the septum sinuum frontalium. The latter is intact and very thin. This septum more nearly approximates the median line than is usually the case.

d—Linear elevation of the dorsal wall indicating a poorly developed septum lateralis.

e—Septum lateralis.

f—Pars orbitalis sin.

g—Pars orbitalis dex.

Contrary to the statement of Sappey,[5] examination of the arcus superciliaris develops no precise information concerning the size of the sinus beyond. The arcus may be larger or smaller than the sinus. In the majority of cases, it is quite true that a large superciliary prominence indicates a large

[4] A series of sagittal sections found this os frontale of an unusual construction; it was thin throughout, the diploë included between the outer and inner tables was reduced to a thin line.

[5] Traité d'Anatomie Descriptive, Ph. C. Sappey, Vol. I, p. 264. Paris, 1888.

cavity behind it and also the reverse, but the presence of an arcus is no guarantee of a sinus in the squama ossis frontalis. One old individual of the series possessed strongly fashioned eminences above the orbits, but had sinuses extending only into the orbital roofs. Casts of these appear in Fig. 4.

Between the sinuses is the septum sinuum frontalium. Proportionate to their extent into the squama, this septum is contracted in breadth and increased in length. It seldom approximates the median line, a fact due to the unequal size of the cavities. When the two sinuses communicate the septum may be perforated at any point in its extent. Usually, however, if not intact, the opening cuts through its caudal extremity. Out of twenty pairs the right sinus was largest in thirteen, the left one in three, and the remaining four were about equal.

Since in the process of their evolution the sinus frontales extend into both the squama and pars orbitalis ossis frontalis, it may be convenient to classify them according to their position; any pair may consist of partes orbitales, or partes frontales, but the latter condition is much more common. If the sinus of one side presents both parts well developed, its mate is usually approximately the same in form. However, when one sinus shows a capacious pars frontalis with only a slight orbital extension, the opposite cavity as a rule will be purely frontal in location.

The pars frontalis is, at times, no more than a slight,

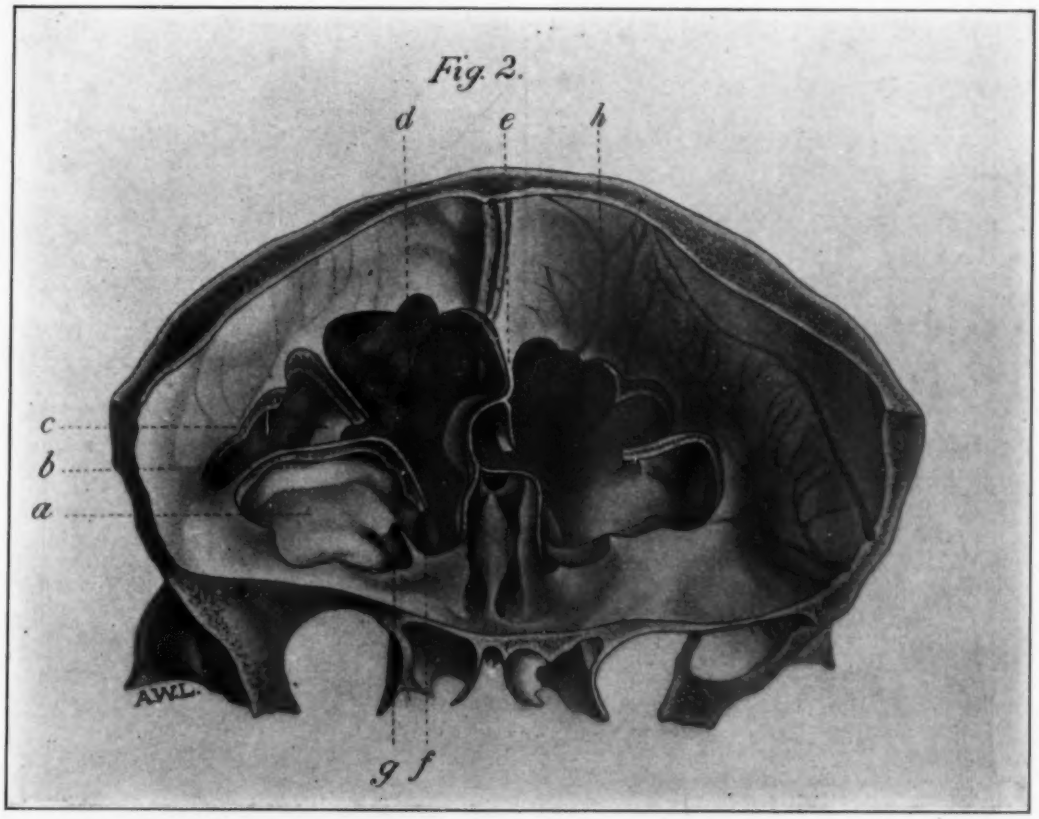

Figure 2.—Nearly all of the bone dorsad of the sinuses is removed. The left sinus is considerably the largest.

a—Pars orbitalis sin.

b—Long, tortuous and thin septum interpartes sin. Its fellow is more ventrally placed, is shorter, thicker and stands in one plane.

c—Septum lateralis sin.

d—Pars frontalis sin.

e—A strip of the inner table of the skull and a trace of diploë corresponding to the septum sinuum frontalium, although the latter is very thin. In this specimen the septum is intact and is in its characteristic, deflected position, but the medial chamber of the right sinus has caused an unusual division of the septum, one arm being continuous with the medial walls of the cavities and the other arm ending by a free, caudal border in the pars frontalis dex.

f.—Bulla ethmoidalis sin.

g.—Septum dorsalis sin. It is longer and thinner than usual. Opposite is seen another septum dorsalis stretching between the dorsal and medial walls of the pars orbitalis dex. and has a free, falciform, cephalic border.

h.—Linear elevation of ventral wall and is all that remains of a one-time septum lateralis.

cephalic dilation of the infundibulum ethmoidale, reaching not further than the caudal level of the glabella (Fig. 8, *A*). While again it will be seen passing cephalad to the caudal circumference of the tuber frontale, stretching laterad to the linea temporalis, or even, according to Hajek,[6] excavating the processus zygamaticus and running dorsad to the sutura sphenofrontalis.

Out of nineteen cases where it appeared on both sides the pars frontalis was largest in thirteen. This frontal portion of the sinus (Fig. 1, *g*), whether large or small, is commonly a single chamber, but it consists frequently of a series of unequally-sized pockets, partially separated from each other

[6] Nebenhölen der Nase. M. Hajek. Leipzig, und Wien.

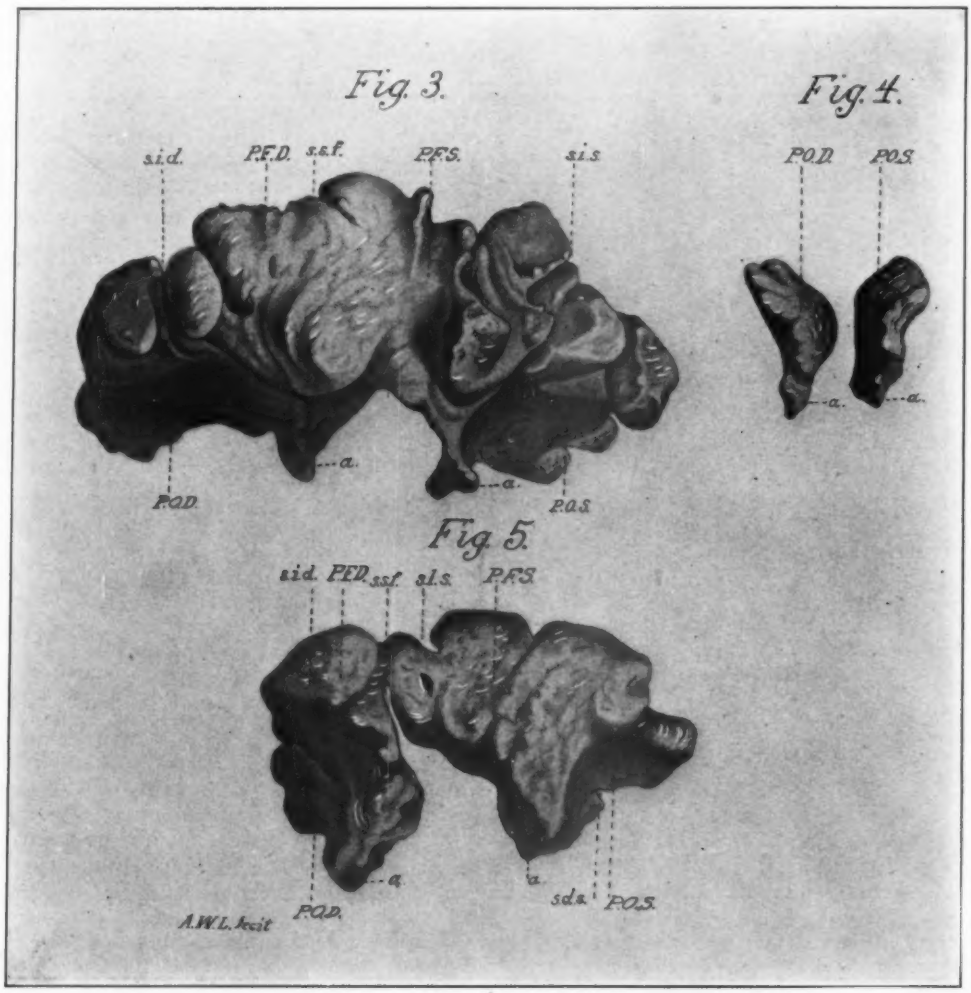

FIGURE 3.—A Wood's metal cast of a large sinus (natural size).
P. O. D.—Pars Orbitalis Dex.
P. F. D.—Pars Frontalis Dex.
P. O. S.—Pars Orbitalis Sin.
P. F. S.—Pars Frontalis Sin.
s. i. d.—Septum interpartes dex.
s. s. f.—Remains of septum sinuum frontalium.
s. i. s.—Septum interpartes sin.
a.—Metal prolongation into the cephalic end of the infundibulum ethmoidale.

FIGURE 4.—Lead casts of a small sinus and representing an instance where the sinuses were purely orbital in development (natural size).
P. O. D.—Pars Orbitalis Dex.
P. O. S.—Pars Orbitalis Sin.
a.—Metal prolongation into the cephalic end of the infundibulum ethmoidale.

FIGURE 5.—Casts of an average pair of sinuses, showing a natural perforation of the septum sinuum frontalium (natural size).
P. O. D.—Pars Orbitalis Dex.
P. F. D.—Pars Frontalis Dex.
P. O. S.—Pars Orbitalis Sin.
P. F. S.—Pars Frontalis Sin.
s. i. d.—Septum interpartes dex.
s. s. f.—Septum sinuum frontalium.
s. l. s.—Septum lateralis sin.
s. d. s.—Septum dorsalis sin.
a.—Metal prolongation into the cephalic end of the infundibulum ethmoidale.

by bony septa. These septa laterales (Fig. 1, *e*) are hung from the cephalic junction of the ventral and dorsal walls of the sinus and, before extending far into the sinus, often end in free, falciform borders. Occasionally they are so long that the several chambers are continuous with each other by very small openings. The septa, however, do not always span the intermural space but exist as low lineal elevations, in the majority of instances on the ventral wall (Fig. 2, *h*, and Fig. 1, *d*.). It is the rule for the septa laterales to increase in number with an increase in the lateral extent of the sinus, but the amplitude of the latter, however, bears no definite relation to the presence of the septa. A large cavity may exist without them (Fig. 7, *A*), while a comparatively small one may possess a number. The capacity of a sinus, moreover, does not seem to influence the form of the septa. In a large cavity the one existing partition is often found so thin that light passes through it almost unobstructed, while those of a smaller sinus may be short and thick.

The type of sinus represented by the pars orbitalis alone often exists on one or both sides. This, however, is much less common than the purely frontal type, or a combination of the two. The pars orbitalis is represented at times by a simple, slight, dorsal extension of the pars frontalis, while at others it reaches out over almost the entire orbital roof. In the series, the pars orbitalis existed bilaterally in ten crania, where that of one side showed no marked size difference with its fellow. Out of twenty-six single sinuses, however, presenting a combination of orbital and frontal parts, the latter was most voluminous in twenty-two.

The pars orbitalis (Fig. 2, *d*) usually passes dorsad from the medial portion of the pars frontalis (Fig. 6, *B. P. O.*), nevertheless it might be an extension from the lateral part of

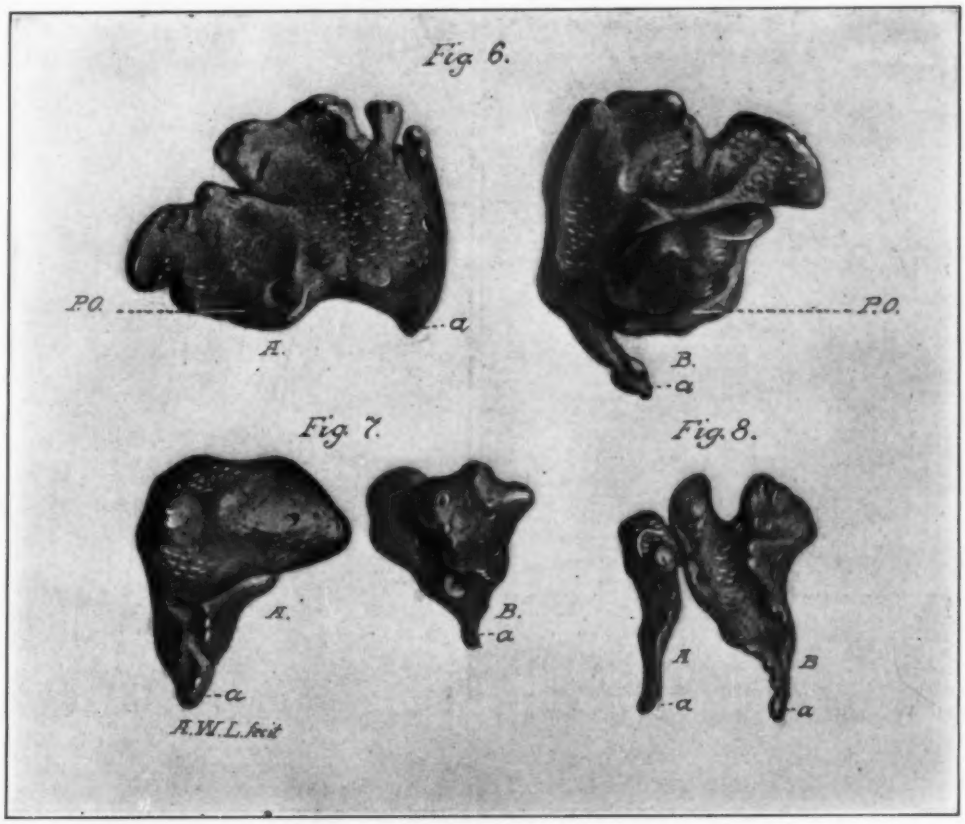

Figure 6.—A and B are casts from different subjects (natural size), dorsal view. They illustrate the variation in position of the partes orbitales. P. O. of A shows a left orbital extension proceeding from the lateral portion of the pars frontalis, while P. O. of B is a pars orbitalis dex., resembling an outstretched wing, passing from the medial portion of the pars frontalis. A long septum interpartes partially separated the masses of metal representing the two divisions of the sinus.

Figure 7.—A and B are casts from the left sinuses of different subjects (natural size), ventral view. A shows no lateral septum, while B, although a smaller sinus, is nearly bisected with an interval created by a long septum lateralis, indicating that these structures have no direct bearing of the size of the sinus.

Figure 8.—A and B are casts from a middle-aged adult (natural size), ventral view, showing one sinus as a simple dilatation of the cephalic end of the infundibulum ethmoidale. The casts A and B are joined by a mass of metal filling an opening in the middle third of the septum sinuum frontalium.

the frontal division of the sinus (Fig. 6, *A. P. O.*). At times both parts communicate with each other very freely, but they usually are divided by a septum reaching medially from the lateral limit of the sinus. This septum interpartes (Fig. 2, *b*) may exist in one sinus and be absent on the opposite side, or, as is usually the case, be present in both. In construction it often varies from a long, thin partition to a short, thick one. Like the frontal division, the pars orbitalis may consist of one or many chambers, but its pockets are seldom as large, since the septa forming them are, as a rule, rarely so deep as the septa laterales. The septa dorsales, subdividing the orbital portions of the sinus, are usually, however, short and thick. Generally speaking, they arise from the lateral and dorsal limits of the pars orbitalis, although they may sometimes pass laterally from the median wall.

The sinus frontalis of the ox excavates the frontal, parietal and occipital bones, making a very large chamber between the

Fig. 9.

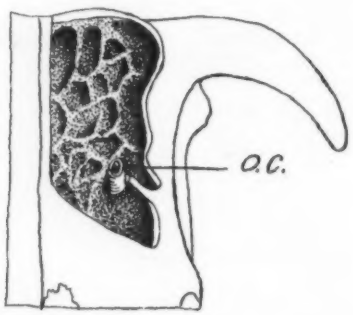

FIGURE 9.—Detail of an illustration from Ellenberg and Baum,[1] showing the immense sinus frontalis of the ox, which excavates the frontal, parietal and occipital bones, as well as the horn.

inner and outer tables which may or may not communicate with its neighbor on the opposite side. The two tables of the cranium are not reinforced by complete bridges spanning the sinus, except around the peripheral portions of the cavity, where thick trabeculæ divide it into small pockets, not comparable in size, however, in size to similar structures in the human skull. The sinus extends up into the horn which near its base is also trabeculated. Dorsad of the horn there is a system of trabeculæ admirably situated for the reinforcement of this part of the skull against strains or shocks imparted through the horns. These also form with the outer table of the skull an eminence for the attachment of the large cervical muscles. That the presence of the sinus in this animal affords some protection against traumatism, is shown by a specimen with an extensively healed fracture of the outer table over the sinus, while the inner table remains intact. It does not seem possible to subdivide the sinus frontalis in the ox's skull into distinct portions, unless they are named arbitrarily from the bones or regions in which they occur.

The frontal sinus in the pig's skull (Fig. 10) excavates the frontal and a portion of the parietal bone. It does not, however, extend into the occipital bone as is the case with the ox. This sinus is usually separated from its neighbor by a complete bony septum somewhat more regularly placed than septum sinuum frontalium in the human cranium, although the partition in the pig may have usually a considerable lateral deflection. This sinus is often subdivided into a pars medialis and a pars lateralis by a septum interpartes which extends anteriorly to a greater or less extent. These two parts, however, do not correspond respectively to the pars frontalis and

Fig. 10.

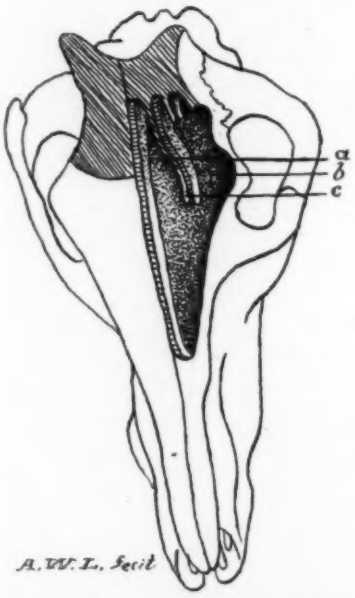

FIGURE 10.—A preparation of an adult pig's skull viewed slightly in perspective. The area shaded with diagonal lines represents a portion of bone removed to exhibit the sinus which excavates a position in the frontal and parietal bones. Here the cavity is differentiated into a pars medialis (*a*) and a pars lateralis (*b*) by a long septum interpartes (*c*).

pars orbitalis of the sinus frontalis in the human cranium. The pars medialis is included between the median and lateral partition and corresponds to the pars frontalis, while the pars lateralis is located between the orbit and the septum interpartes corresponding to the pars orbitalis of the human sinus frontalis. The two portions of the sinus communicate anteriorly. As in the human and other specimens, the sinus is subdivided around its periphery by a series of small trabeculæ into small pockets. These, however, cannot lend a great deal of additional strength in reinforcing the vault of the cranium, but the septum interpartes (Fig. 10, *c*) reaching from the outer to the inner table and extending forward through the broader part of the sinus contributes a great deal to its struc-

[1] Handbuch der Vergleichenden Anatomie der Hausthiere. Ellenberg u. Baum, p. 102, Berlin, 1900.

tural strength. The sinus frontalis in the sheep is limited to the ventral and lateral portions of the ossis frontalis. Its depth in the maximum is from 0.7 to 1.5 centimeters. Like the sinus in the pig's skull, it is subdivided into two portions by a septum interpartes and the trabeculæ around the periphery of the sinus are much more developed, exaggerating the sacculation of the sinus to even a greater degree than is shown in Fig. 11.

In the dog the frontal sinus (Fig. 12) shows an irregularly spherical or ovoid cavity in the frontal bone, usually completely separated from its mate by the septum. No trabeculæ bridging the tables are found in this skull and those around the periphery of the sinus are only developed to the extent of slight ridges, thus causing a slight sacculation of the periphery

Fig. 11.

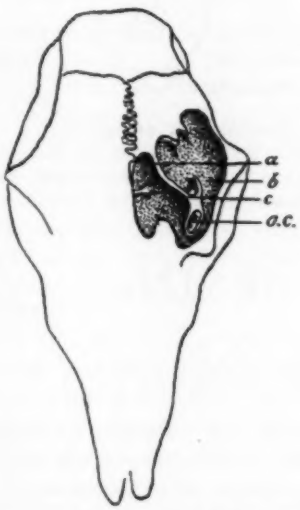

FIGURE 11.—A preparation of an adult sheep's skull, where the sinus frontalis is confined to the frontal bone.

a—Pars medialis.

b—Pars lateralis.

c—Septum interpartes.

The latter in this animal has the additional function of lending support to the osseous tube O. C., which transmits into the superciliary vessels and nerve.

of the sinus. In the skull of the cat (Fig. 13) the sinuses are limited to the frontal bone and are completely separated from each other by the septum sinuum frontalium. This cavity can often be divided into the pars frontalis and the pars orbitalis by a septum interpartes, the orbital portion extending lateralward out into the orbital process of the frontal bone. With the exception of this septum, there are no trabeculæ save those indicated by mere ridges to interrupt further the regular outline of the sinus. In monkeys there is no sinus frontalis present, notwithstanding the well-developed arcus superciliaris. There are, however, a large number of dilated bony cells which occupy a similar position to the sinus frontalis as it is found in other animals. These rarefied bone cells take the place of the sinus and probably communicate with each other and the nasal meatus, although injections to prove this point were not made. In horned animals trabeculæ are arranged so as to provide not only for the strength of the sinus and the protection of the cerebrum, but also as a reinforcement against stress applied to the skull through the horns. No gradual increase or decrease in complexity can be followed through the animal series, the sinus seeming to adapt itself in each species toward the architecture of the skull to the end that it affords at the same time lightness and strength.

It has been suggested that the frontal sinuses are being

Fig. 12.

FIGURE 12.—A preparation of an adult male dog's skull, and shows the sinus entirely within the frontal bone.

eliminated from the vertebrate skeleton by a process of evolution, owing to their occasional absence in otherwise normal human crania, their irregularity in form, extent and capacity, as well as their extreme asymmetry. But a comparison of the sinuses in a series of mammals shows no diminution in their size corresponding to the position of the species in the animal scale. Moreover, the extreme modification presented by the sinuses in monkeys also seems to argue against the plausibility of the suggestion.

Inspection of a comparative table of the relation of brain weight to body weight in the series of mammals compiled by Leurent and Gretiolet reveals the following facts:

For example, in the horse and pig the ratio of brain weight to body weight is respectively 1 to 582 and 1 to 481, that is to say, the proportion is much smaller in the pig than in the horse and yet the former has the largest frontal sinus. It appears from these two instances, which can also be amplified

by others in the table, that there is no distinct relation between brain weight in its relation to body weight and the sinus frontalis. This also appears to be the case in reference to the relation between the cranial capacity and the size of the skull, for monkeys, which next to man have the highest relative cranial capacity, possess only a modified frontal sinus as the tissue beneath the well-developed superciliary arches consists simply of dilated pneumatic cells.

Fig. 13.

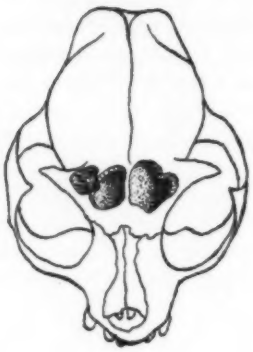

FIGURE 13.—A preparation of an adult female cat's skull with the sinuses situated in the frontal bones.

Fig. 14.

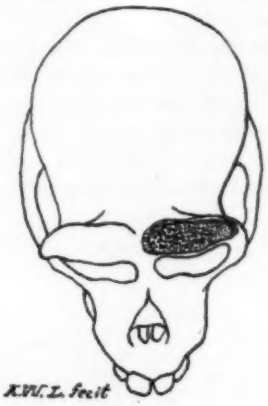

FIGURE 14.—A preparation of an adult male monkey's skull (species unknown). No sinus exists in the usual form. The arcus superciliaris sin. has been cut and shows the sinus, consisting of dilated pneumatic spaces.

A MODIFIED NOCHT'S STAIN.

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The numerous methods of blood staining and the many staining fluids described during the last seven years have had as their objects to be attained the doing away with separate fixation and the development of the malarial "chromatin-staining" material.

The stains described by Romanowsky, Ziemann, Nocht (1), Jenner (2), Goldhorn (3), Leishman (6), Michaelis (7), Reuter (8), Willebrand (9), Wright (10), and Schegoleff (11) possess at least one of these qualities, and Leishman's and Wright's possess both of them. None of these methods, however, gives constantly and without fail the clear, intense staining obtained by employing Nocht's principle of mixing the three solutions of eosin, alkalinized-methylene-blue, and methylene blue. Nocht (12) pointed out that the essential staining element of the Romanowsky and Ziemann methods is a new staining material, which he designated as "red from methylene blue" (Michaelis' (13) "methylen-azur," or "azur-blau"), which is formed in all alkaline-methylene-blue solutions.

While using Nocht's methods according to the directions given by Lazier (4) and by Ewing (5), the possibility of preparing a Nocht's solution with methylic alcohol suggested itself—a combination of Nocht's and Jenner's methods.

After several trials such a solution was obtained, but little or no differentiation of leucocyte granules and no "chromatin-staining" were obtained until Leishman's publication suggested the method of differentiation by diluting the staining fluid with distilled water.

The stain-powder is made as follows from the dry, powdered water-soluble yellow eosin and the dry, powdered Ehrlich's rectified methylene blue (or medicinal methylene blue):

A. Eosin solution .....1% aqueous.
B. Alkaline-methylene-blue solution..1%
C. Methylene blue solution.....1% aqueous.

B (Nocht, 14) is freshly prepared by adding to a warm 1% solution of dry, powdered sodium carbonate (Na_2Co_3) 1% of methylene blue powder; heating this mixture over a water-bath for 15 minutes; adding 30 cc. of water for each 100 cc. of original fluid to replace loss by evaporation; and heating a second time over water-bath for 15 minutes (to make up one lot of stain 200 cc. of this solution B should be prepared). This warm alkaline-methylene-blue solution is poured off from the gummy residue, partially neutralized with 5-6 cc. of 12½% acetic acid, and mixed with solutions A and C, as follows:

Distilled water	1000 cc.
Eosin sol. A	100 cc.
Alkaline-methylene-blue sol. B	200 cc.
Methylene-blue sol. C	70-80 cc.

If 70 cc. of solution C is not a sufficient quantity to produce a fine precipitate, this solution (C) is added until the precipitation is obtained (70-80 cc. in toto).

This mixture of three solutions is allowed to stand ½ to 1 hour, filtered through one filter, the residue allowed to dry in the air for 24-36 hours, and this dry residue is dissolved in Merck's pure methylic-alcohol.

From the quantities given above one obtains usually 0.7 to 0.9 gramme of dry, brittle residue, and 0.3 gramme of this dry residue in 100 cc. of methylic-alcohol results in the satisfactory staining solution. The residue is soluble with difficulty and must be rubbed well in a mortar with pestle to obtain solution.

To use the stain no previous fixation is required. The dried blood smears are flooded with the staining-solution for 1 minute; the solution is then diluted with distilled water (5-7 drops for ⅞-inch cover-slip) and this diluted stain allowed to act for 5 minutes; the specimen is washed thoroughly with distilled water, care being taken to clean off with the fingers the negative side of the glass upon which a precipitate collects; blotted with filter-paper; mounted in balsam.

The colors of nuclear material, granules, plates, red cells, malarial parasites, are similar to those found in specimens stained by Nocht's method.

Bottles of the staining fluid two years old retain their fixing and staining properties, provided the stain is always poured from the bottle and pipettes are not used, for slight changes in reaction of the fluid destroy the staining properties. Stained specimens do not fade, but are found well stained after a period of two years. Specimens several weeks old may not stain well; specimens several months old never stain well; and leukemic specimens rarely stain well after six to eight weeks.

The chromatin material of the malarial parasite stains clearly. The stippling of Schüffner (15) and of Ruge (16) is well shown. All the leucocyte granulations are well differentiated.

The granular-basophilic and polychromatophilic changes in the red cells are well shown. The blood plates stain clearly.

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COMPLICATIONS ARISING FROM FREEING THE URETERS IN THE MORE RADICAL OPERATIONS FOR CARCINOMA CERVICIS UTERI, WITH SPECIAL REFERENCE TO POST-OPERATIVE URETERAL NECROSIS.

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Associated with the advance in all forms of surgery, there arises a new series of complications which must be recognized, remedied and finally avoided. The most serious complication which has been associated with the advance in the operative treatment of carcinoma cervicis uteri has been that of injury to the ureter. Since the opening of the Johns Hopkins Hospital in August, 1889, until January 1, 1904, there have been admitted to the gynecological department of this hospital 10,961 patients. Of these, 8590 have undergone an operation of some sort. There have been 4669 major operations, which term includes all coeliotomies, both abdominal and vaginal, and all operations on the kidney. There have been 31 instances of accidental injury to the ureter, only one of which occurred in a minor operation, a ligation of the ureter in repairing a vesico-vaginal fistula. Of these 31 cases, 19 occurred in hysterectomy for carcinoma of the cervix. Accidental injury to the ureter as a complication associated especially with hysterectomy for carcinoma cervicis uteri becomes very evident when one considers that there have been 19 instances of injury to the ureters in 156 hysterectomies for cancer of the cervix, as compared with only 11 cases in 4513 other major gynecological operations. These injuries have

been of various kinds, as ligating, clamping, cauterizing, cutting, and interfering with the blood-supply of the ureter so that necrosis occurred with a resulting uretero-vaginal fistula. Some of these injuries were recognized at the time and repaired, while others were not discovered until afterwards. The cases of accidental ligation and clamping of the ureter have been published.[1]

All who are interested in the operative treatment of carcinoma cervicis uteri recognize that hysterectomy alone effects a cure in but a very small percentage of the cases. The comparison of statistics is very unsatisfactory and misleading. Over a year ago all our cases were reviewed, and we found that only about 12 per cent were free from recurrence at the end of five years, and about 23 per cent at the end of three years. In addition, there had been a primary mortality of 14. + per cent. If 14. + per cent die as a result of the operation, and about 88 per cent of the cases recur within five years after the operation, it is little wonder that cancer of the cervix is looked upon by many as an incurable disease, especially when, in addition, it is considered that in about three-fifths of the patients admitted to this hospital with this disease, the growth had extended beyond operative treatment.

I have studied the relation between the ureters and carcinoma cervicis uteri and these results[2] have been published. In this article the work of Kundrat[3] was reviewed, who studied the parametrium in 80 of Wertheim's cases. He showed that the parametrium was involved in 44 of these cases, and that apparently in 22 of these 44 cases the parametrium had been able to stop the further extension of the disease, as shown by a study of the pelvic lymphatics beyond the parametrium, thus emphasizing the importance of a wide excision of the parametrium. Kundrat also showed that only by the microscope can one diagnose the presence or absence of cancer in the parametrium, as has been emphasized by both Wertheim[4] and myself.[5]

A study of the relation between the ureters and the cervix shows that this varies in different cases and may be altered by physiological and pathological conditions, and also by various steps in gynecological operations. At the point where they enter the parametrium they may be 2 to 3 cm. distant from the cervix, while where the ureters enter the bladder the distance may be less than 5 mm., depending on the position of the uterus in the pelvis, it therefore may take but a very slight involvement of the parametrium by cancer for the growth to reach or extend beyond the ureters.

In carcinoma cervicis uteri this relation is altered in the following ways, as has been described in the above-mentioned article:[6]

1. By the distention of the cervix by the growth, thus bringing the cervix nearer the ureters.

2. By the direct invasion of the parametrium by the growth, and as this is apt to occur in the lower part of the parametrium, it does not need to go far in order to reach or extend beyond the ureters.

3. By metastases to the structures of the parametrium; as,

a. The large parametrial lymph nodes, especially the one sometimes found where the uterine artery crosses the ureter.

b. The minute parametrial lymph nodes, scattered throughout the parametrium, and which may be involved by carcinoma without increasing in size.

c. The (intravascular?) lymph nodes, also minute, which apparently protrude into the lymph channels like sponges and are apparently different in structure from the other minute lymph nodes, but like them may be involved by cancer without increasing in size, so that their presence can only be diagnosed with the microscope.

d. Other structures of the parametrium, as nerve sheaths, lymph channels, etc.

It becomes very evident that the ureter passes through tissue which should be removed; as shown by:

1. The large percentage of recurrences after hysterectomy for this disease.

2. The renal insufficiency resulting from the extension of the disease, thus compressing the ureters.

3. The accidental injury to the ureters in the operative treatment of the disease.

4. The anatomical relation between the cervix and the ureter under normal conditions shows that this relation is changed by the position of the uterus in the pelvis and the size of the cervix, and that in the lower portion of the parametrium it takes but very little involvement of this tissue by the cancer for the growth to reach or extend beyond the ureters.

5. The study of the parametrium by Kundrat in 80 operable cases showed that it was involved in over half the cases, and that in *half the cases in which it was involved, it had apparently checked the further advance of the growth,* as shown by a study of the pelvic lymphatics beyond the parametrium.

6. The study of the cases in which the ureters have been resected shows how easily the growth can reach or extend beyond the ureter, either by direct extension or by metastases, and that the diagnosis of cancer about or near the ureters can be definitely made only with the microscope, as shown by me in the article[6] previously referred to.

Two ways of removing all the tissue from pelvic wall to pelvic wall present themselves:

1. To dissect the ureters free from this tissue.

2. To remove the tissue with the lower ends of the ureters and implant the renal ends of the ureters into the bladder.

The object of this paper is to consider the effect of freeing the lower ends of the ureters in these operations, and whether or not it is justifiable, and if so how it should best be done. In order to determine the above, the subject must be viewed from the results of anatomical, experimental and clinical studies.

What Takes Place when the Ureters are Freed in the More Radical Operations for Carcinoma Cervicis Uteri.

If one will catheterize both ureters with silk bougies and, after grasping the cervix with traction forceps, make a bi-

manual pelvic examination, the relation between the cervix and the ureters may be determined, for the catheterized ureters can be easily palpated. While making the examination, if another person will displace the uterus by means of traction forceps, as pulling it down, pushing it up in the pelvic cavity and displacing it to the right or left side of the pelvis, a very good idea may be obtained of what effect these positions of the uterus have upon the ureters, which one can readily feel in the bimanual examination. Under normal conditions, the ureters are only slightly affected by these positions, unless extreme, and one can see that the distance of the ureters from the cervix is dependent mainly on the position of the uterus in the pelvis; i. e., when the uterus is in the right side of the pelvis, the left ureter bears nearly the same relation to the left side of the pelvis as the right does to the right side of the pelvis. On the other hand, the uterus is nearer the right ureter than the left, the distance depending on the degree of displacement. I studied these relations still more satisfactorily in the pelvis of a multipara, only a few hours after death. Catheters were inserted in the ureters from above and the bladder was opened and the catheters withdrawn until the ends appeared just at the ureteral orifice in the bladder. A bimanual examination was now made with one hand in the pelvis and the other in the vagina. The uterus was displaced by pulling it up in the pelvis, drawing it down and displacing it to the right and left side. While extreme displacement in either direction also displaced the ureters, one could see that the relation between the ureters and the cervix was mainly dependent on the position of the uterus in the pelvis, and that under normal conditions any displacement of a freely movable uterus, unless extreme, changed but very little the relation of the ureters to the sides of the pelvis and other fixed pelvic structures.

The pelvic portion of the ureter is surrounded by a sheath (described in previous articles [2 and 6]), which is adherent to the peritoneum in that part of the pelvic portion of the ureter which lies just under the peritoneum and situated above the parametrium (when the uterus is in anteposition; for in the retroposition the uterus may lie posterior to the ureters for their entire pelvic portion). The sheath of the lower pelvic portion of the ureter is firmly connected with the tissue along or through which the ureter passes and from which the sheath is derived and the isolation of this portion of the ureter with its sheath is very difficult. On the other hand, the sheath may be split open and the ureter easily shelled out. In freeing the ureters they are usually shelled out from this sheath and thus all vessels coming to that portion of the ureters are injured, and in addition there is danger of injuring their outer perimuscular fibrous coats, in which are situated the larger ureteral vessels. At the close of the operation the ureters lie in the pelvis as loose cords, deprived of their sheaths, and exposed to the danger of ureteral necrosis or ureteral obstruction.

In considering the effect of freeing the pelvic portion of the ureter, a knowledge of the efficiency of the blood-supply of the ureter is most important, and such knowledge can only be gained from anatomical, experimental, and clinical studies. A result of such studies has been published in a previous article.[6]

The Blood-Supply of the Ureter.

The ureter is nourished by a periureteral arterial plexus, the main trunks of which run in a longitudinal direction from the kidney to the bladder in the outer loose perimuscular fibrous coat of the ureter. From these longitudinal vessels small branches arise, some of which anastomose with each other, thus forming the mesh-work of the plexus. These smaller branches are, for the most part, more deeply imbedded in the outer coat of the ureter than the main trunks which in places may be but loosely united to the ureter. Small arteries arise from this plexus, penetrate the walls of the ureter, and thus supply the inner coats of the ureter. I do not know whether or not there is a free anastomosis between the deeper ureteral arteries. In sections of the ureter cut from specimens injected with Prussian-blue the free anastomosis of the capillaries can be demonstrated easily. On the other hand, I have never been able to determine whether or not there was any anastomosis between the small arteries found within the muscular coats. These vessels are not very numerous and are very small, as shown in Fig. II, and one would not suppose that they could nourish the ureter for any distance unless the plexus remained intact. This plexus is nourished mainly by the ureteral arteries which arise from branches of large vessels along the course of the ureter, as the aorta, renal, ovarian, iliac, uterine, and other arteries. The ureteral arteries are not the same in all cases, as a branch from one artery, as, for instance, the ovarian, present in one case, may be absent in another, and its place be taken by a branch from another artery, as the aorta, a ureteral branch of which may not be present in the first instance or both may be present in the latter case (see Fig I). This plexus may receive additional nourishment from small branches arising from the plexus of vessels which supply the tissue about the ureter, and may anastomose with the branches of other vessels supplying these parts.

An idea of the efficiency of this plexus may be gained from the following experiments which I made. In five instances the arteries of the ureter for its entire length were injected by inserting a canula into the renal artery through the incised aorta, using an aqueous solution of Prussian-blue in two instances and a 15 per cent solution of gelatine colored with ultramarine-blue in the other three. Fig. I was drawn from one of these specimens. The internal iliac artery was injected in the opposite side of one of the above cases, and as a result the arteries of the ureter were injected for its entire length. I have injected the internal iliac artery in another instance, the ovarian in one, and the abdominal aorta in two, first clamping the renal, iliac, and lumbar arteries in the latter two cases so that the coloring material could not enter these vessels. This latter group of cases was not quite as satisfactory as the first six cases referred to, as the work was done after the organs had been removed; nevertheless,

they all demonstrated the free anastomosis of the arteries of the ureter, giving rise to a periureteral arterial plexus, and showed that it is possible to inject the entire plexus from such arteries as the renal and internal iliac, and also probably from any one artery which furnishes a ureteral artery. Through this plexus there is established an arterial communication between the kidney and the bladder, because when one injects the renal artery alone with ultramarine-blue, the particles of which will not enter the capillaries, in addition to the injection of the ureteral arterial plexus, both the bladder and the uterus are partially injected. The anastomosis of the renal with the ovarian and the latter with the uterine also aids in bringing this about.

From a knowledge of the blood-supply of the ureter it would seem that many liberties could be taken with the ureter without causing necrosis; as, for instance, the ureter could be dissected free, from the bladder to the kidney, severing all vessels coming to the ureter between these organs, and yet necrosis would not occur if the periureteral arterial plexus remained intact.

On the other hand, one would suppose that the destruction of this plexus for only a short distance would lead to necrosis of the ureter, for even if there existed a free anastomosis of the deeper arteries of the ureter, on account of their size and small number, one would think that they would not be capable of maintaining the nourishment of the ureter for any great distance.

Experiments on Dogs Demonstrating the Efficiency of the Blood-Supply of the Ureter.

In the article* previously referred to, I gave the results of some of my experiments and referred to the work of Monari, who showed that many liberties could be taken with the ureter of a dog, as it could be freed from the tissue surrounding it and if replaced in this tissue necrosis would not occur. On the other hand, if the ureter was freed, but for a short distance and gauze was placed about it, necrosis was very apt to occur.

There is an arterial plexus about the ureter of a dog very similar to that found in man. It receives branches from the vessels near it and presents variations much as are found in human beings. The main trunks of this plexus tend to arrange themselves in two relatively large branches, one on each side of the ureter, which are loosely bound to the ureter. The smaller branches arising from the trunks anastomose with each other, thus forming the mesh-work of the plexus, and are more closely united to the ureter than the larger vessels, as is also the case in man. On this account it is quite easy to injure the large trunks but not the smaller branches (see Figs. III, IV and V). The following experiments were done:

I. In seven dogs, the ureter was isolated for nearly its entire length and an attempt was made to strip off the periureteral arterial plexus with my finger nails. The dogs were killed in from one to four weeks and ureteral necrosis occurred in only two cases. In four of these cases the descending aorta was injected with a 15 per cent solution of gelatine colored with ultramarine-blue, and very satisfactory injections of the ureter were obtained. It could be seen in these specimens that in trying to strip off the arterial plexus I had removed only portions of the main arterial trunks and the large veins, while most of the smaller branches, which are imbedded more deeply in the outer coat of the ureter and form the mesh-work of the plexus, were uninjured and were able in five instances to maintain the arterial plexus, and thus the blood-supply of the ureter. In addition newly-formed vessels come to the ureter from the surrounding tissue, and also new vessels go out from the ureteral plexus into the surrounding tissue (see Fig. III).

II. In three cases the ureter was isolated for about 4 cm. and in order to completely destroy the plexus, the ureter was scraped on all sides with a very sharp knife, for a distance of 2 cm. Necrosis occurred in all three cases.

III. In three dogs a ureter was isolated for nearly its entire length, and then the larger vessels of the plexus were torn off by the finger nails and mouse-tooth forceps, as in the first experiments. Both uterine vessels were tied, thus ligating the ureteral arteries which complete the lower end of the plexus and arise from the uterine. Necrosis occurred in each instance.

IV. An attempt was made to simulate the condition sometimes found after the more radical operations for cancer of the uterus. In six dogs the ureter was isolated for about its lower one-third, and the tissue about it, including portions of the larger vessels of the plexus, was torn off as above. Both uterine arteries were tied and necrosis occurred in five of the six cases.

V. In two dogs the above was done, except the uterine artery on only one side was tied. Necrosis occurred in one case.

VI. In twenty-five uretero-vesical implantations in dogs, there was but one failure, which occurred in one of nine cases where organisms had been introduced into the bladder, in order to see the results of implanting the ureter in the presence of infection. In three of these nine cases the kidney became infected and in each instance there was a marked stricture of the ureter at the seat of the implantation.

VII. In another dog the ureter was freed and stripped, as in previous operations. A small rubber tube 8 cm. long was split, and by springing it apart the ureter was placed within its lumen. Necrosis of the ureter occurred for a length of 7.5 cm.

VIII. A dog's ureter was scraped with a sharp knife until a fistula was formed. The ureter was replaced in the abdominal cavity and 53 days afterwards the dog was killed. The kidney was found to be normal, the ureter patent, and there was no evidence of there having been any trouble except for the adhesions about the ureter.

It is evident that in a dog the ureter may not only be freed for its entire length, but its larger vessels may, in part, be destroyed by stripping them off; yet necrosis will not necessarily occur, for the plexus may be maintained by the

smaller branches which are more adherent to the ureter and are very difficult to remove, and also by such portions of the large branches as have not been destroyed. On the other hand, when the ureter is scraped with a sharp knife, thus destroying the smaller branches as well as the larger, necrosis will occur, even though the distance be very short. Again, when the ureter is freed but a short distance and the plexus interfered with, and in addition the arteries supplying the lower end of the ureter are ligated, then necrosis is very apt to occur, for the portion of the ureter stripped and also that below the injury, must receive most of its blood-supply from the blood-vessels in the plexus above the injury, and the stripping may interfere with the blood reaching these parts through the injury to the plexus.

In injury to the ureteral plexus, veins are destroyed as well as arteries, but as there is a very free anastomosis between the veins of the ureter, one would expect much less trouble from injury to the veins. Nevertheless, it must embarrass the circulation to a degree, varying with the extent of the injury. Infections, exudates, and foreign material, as gauze, must all be considered as accessory etiological factors in the causation of ureteral necrosis.

So far, the results of the study of the blood-supply of the ureter in man and experiments on animals tally. The next thing to be considered is what may be learned from clinical experience.

Clinical Cases Demonstrating Some of the Injurious Results Arising from Freeing the Ureters in the More Radical Operations for Carcinoma Cervicis Uteri.

Clinical cases showing the efficacy of the blood-supply of the ureter have been referred to in a previous article. In this article attention was called to the fact that many liberties could be taken with the ureter. The human ureter has been dissected free for its entire length and yet necrosis has not occurred, and even when its outer coat is injured the ureter may be preserved. On the other hand, if the periureteral arterial plexus is injured sufficiently necrosis will occur.

There have been six instances of ureteral necrosis in 156 hysterectomies for cancer of the cervix in this hospital, and not a single instance of such a complication following the many times that the ureter has been accidentally exposed in other gynecological operations. I have abstracted the main points in these six cases.

Case I.—Mrs. M. W. Age 46. Gyn. No. 5991. Gyn. Path. No. 2301.

Diagnosis: Squamous cell carcinoma cervicis uteri.

Prognosis bad, for sections through the edge of excision of the growth showed that it probably had not been all removed.

Operation: Hystero-salpingo-oöphorectomy, combined abdominal and vaginal, with preliminary catheterization of the ureters with silk catheters.

Steps in the Operation Interfering with the Blood-Supply of the Ureters.

1. The right ureter was found to be surrounded by the growth and with difficulty was dissected free from it.

2. Uterine arteries were tied.

3. Pelvis drained through the vagina with gauze, which probably came in contact with the right ureter.

Nature of the Ureteral Injury.

Right uretero-vaginal fistula, appearing on the ninth day when the pelvic packs were removed. Otherwise, convalescence was uneventful.

Result: Six weeks later an attempt was made to turn the uretero-vaginal fistula into the bladder, by a plastic operation through the vagina. Operation was unsuccessful. The fistula persisted until death two month later, apparently from renal infection.

Case II.—Mrs. S. R. Age 24. Gyn. No. 8788. Gyn. Path. No. 4994.

Diagnosis: Squamous cell carcinoma cervicis uteri.

Prognosis bad, for from a microscopical study of the specimen the growth had apparently not been all removed.

Operation: V, 30, 1901. Hystero-salpingo-oöphorectomy, combined abdominal and vaginal, with preliminary catheterization of the ureters, with silk catheters.

Steps in the Operation Interfering with the Blood-Supply of the Ureters.

I. Both ureters were dissected free from the carcinomatous cervix to which they were adherent. The right ureter was the more adherent. The ureters thus stood out like two cords from above the middle of their pelvic position to their insertion into the bladder.

II. Both internal iliac arteries were tied.

III. Gauze drains were placed through the vagina, which probably came in contact with the ureters.

Nature of the Ureteral Injury.

Right uretero-vaginal fistula, manifesting itself by a discharge of urine from the vagina on the tenth day.

Result: Patient died a year later from recurrence of the growth. Fistula persisted off and on until shortly before death.

Case III.—Mrs. A. M. Age 64. Gyn. No. 9256. Gyn. Path. No. 5757.

Diagnosis: Squamous cell carcinoma cervicis uteri.

Prognosis bad, for the growth had extended out to the edge of excision.

Operation: Hystero-salpingo-oöphorectomy, combined abdominal and vaginal, preliminary catheterization of the ureters.

Steps in the Operation Interfering with the Blood-Supply of the Ureters.

I. Both ureters were dissected free from about the middle of their pelvic portion to their entrance into the bladder.

II. The left internal iliac artery was ligated. On the right side the uterine artery was ligated at its origin.

III. The pelvis was drained through the vagina with gauze, which probably came in contact with the ureters.

Nature of the Ureteral Injury.

Bilateral uretero-vaginal fistula; bilateral renal infection.

Convalescence: Uneventful until the tenth day, when urine appeared in the vagina and none was present in the bladder. A month later urine came from both vagina and bladder, and the presence of purulent urine in the bladder, with chills and fever, the temperature reaching 103° suggested renal infection. Six weeks after the operation, the vaginal leakage ceased. Cystoscopic examination made at that time showed that there was a stricture of the left ureter, for a catheter could be forced but 2 cm. into the ureteral orifice, while on the right side a catheter was passed 5 cm. into the ureter, passing three strictures, and purulent urine escaped from the catheter, thus indicating renal infection.

Result: A letter received from her physician a short time ago, 18 months after the operation, stated that at present there was no evidence of a return of the growth and that the patient was apparently in good health.

Case IV.—Mrs. N. B. Age 64. Gyn. Nos. 9492, 9534, 9881 and 10,168. Gyn. Path. No. 5758.

Diagnosis: Squamous cell carcinoma cervicis uteri.

Prognosis bad, for sections showed that the growth had extended out to the edge of excision.

Operation: Hystero-salpingo-oöphorectomy, abdominal with Downes cautery clamp. Preliminary catheterization of the ureters.

Steps in the Operation Interfering with the Blood-Supply of the Ureters.

I. The left ureter was dissected free for its lower pelvic portion as the left broad ligament was involved by the growth.

II. Cautery clamps, which are apt to burn further than would appear, and by destroying surrounding tissue interfere with secondary collateral circulation, were used.

III. Pelvic drains of gauze, which probably came in contact with the left ureter.

Nature of the Ureteral Injury.

Left uretero-vaginal fistula. On the fifteenth day a large amount of watery vaginal discharge was noticed, and later a diagnosis of left ureteral fistula was made. Cystoscopic examination made four weeks after the operation showed that a portion of the urine came from the ureter into the bladder and a portion through the fistula. Leakage from fistula stopped five weeks after the operation, or three weeks after the appearance of the fistula. The patient was readmitted September 5, 1902, three and a half months later. A diagnosis of bilateral renal infection made. Urine from both kidneys was turbid. Repeated washing out of both kidneys through renal catheters with silver nitrate, 1-2000, improved her general condition and she left the hospital much improved after remaining here two months. At this time there was no evidence of a return of the growth.

Patient returned January 5, 1903, after two months' absence. She felt better for the first few weeks but afterwards began to have pain in her left groin and large quantities of pus in her urine. Irregular nodular masses could be felt in the lower part of the pelvis. The cancer had returned.

Result: Return of carcinoma. Bilateral renal infection.

Case V.—Mrs. C. H. Age 49. Gyn. No. 10,084. Gyn. Path. No. 6284.

Diagnosis: Squamous cell carcinoma cervicis uteri. Local growth all removed, but metastases were found in the lymph nodes of the parametrium.

Operation: Hystero-salpingo-oöphorectomy, abdominal. Preliminary catheterization of the ureters.

Steps in the Operation Interfering with the Blood-Supply of the Ureters.

I. Both ureters were dissected free from their entrance into the parametrium to the bladder.

II. The uterine arteries were ligated and cut lateral to the ureters.

III. The pelvis was drained through the vagina with gauze, taking care that it should not come in contact with the ureters.

Convalescence: Patient did badly; died on the sixth day. Pulse rapid, temperature rose to 103.2° on the sixth day, but fell to 100.2° in the next eight hours, and just before death rose to 101.4°. Patient was drowsy, although the amount of urine excreted was over 1 liter a day after the first 48 hours.

Autopsy was negative. Cause of death not found. The ureters were carefully examined for any evidence of necrosis and in the right ureter, about 2 cm. above its entrance into the bladder, there was found a slight aneurysmal dilatation. Fig. XXII is a drawing made from a longitudinal section of the ureter at this place, showing that local necrosis has occurred and that the ureter is about to rupture at this point, thus giving rise to a ureteral fistula.

Result: Death as result of operation; cause not determined. Ureteral necrosis.

Case VI.—Mrs. A. M. Age 48. Gyn. No. 10,622. Gyn. Path. No. 6860.

Diagnosis: Squamous cell carcinoma cervicis uteri. Lymph node removed from the division of the left common iliac into

the internal and external branches was found to be carcinomatous.

Operation: VII, 25, 1903. Abdominal hystero-salpingo-oöphorocystectomy. Freeing the lymphatics from the pelvic vessels and removing with them the uterus and growth, together with all the parametrium. The ureters were dissected free from their parametrial sheath by splitting it open lengthwise from its outer side. Preliminary catheterization of the ureters.

Steps in the Operation Interfering with the Blood-Supply of the Ureters.

I. Both ureters were dissected free from their parametrial sheath for a distance of 4 cm.

II. Both uterine arteries were tied at their origin.

III. Gauze drainage: (a) Through vagina, but gauze did not come in contact with the ureters; (b) sides of the pelvis lateral to the ureters were drained extraperitoneally through incision made just above Poupart's ligament on both sides. Possibly the lateral extraperitoneal drains came in contact with the ureter.

Nature of the Ureteral Injury.

Convalescence was uneventful until the thirteenth day, when urine appeared in the vagina. Flank drains were started in two days and removed in four days. Pelvic drains through vagina were all removed by the seventh day.

The patient left the hospital four weeks after the operation, with a severe cystitis, all the urine from the left kidney coming through the vagina.

Patient was readmitted two weeks later. Apparently all the urine from the left kidney came through the vagina.

Cystoscopic examination: Bladder apparently normal. Urine cultures showed a growth of colon bacillus. About one-half of the urine came through the vagina. IX, 15, 1903, 53 days after the first operation, the left ureter was resected and reimplanted in the bladder, through an incision parallel to Poupart's ligament, extraperitoneally. Cocain in the form of Schleich's solution was used as a local anesthetic. There was no evidence of leakage until the eighth day, when apparently about half of the urine came through the inguinal incision. Firm pads were placed over this incision and a tight bandage was put in; the leakage ceased but *the amount of urine passed through the bladder did not increase*. The patient did not have any untoward symptoms. A week later the amount of urine excreted each day had gradually increased, but did not reach the amount passed before the leakage had occurred. As no urine appeared at the site of the inguinal incision, a probable diagnosis was made of occlusion of the ureter. This was apparently confirmed by cystoscopic examination. The end of the ureter could be seen in the bladder, but repeated examinations over long periods of time failed to show any evidence of urine coming from the ureter, and repeated attempts at catheterizing the ureter failed. The catheter could be passed in about 1 cm. and then met an obstruction. The most probable diagnosis was that a second ureteral fistula had resulted from ureteral necrosis, and as it had time to become imbedded in scar tissue before forming, firm pressure had favored an occlusion of the ureter with a resulting cure of the fistula, but at the same time destruction of the kidney without any localizing or constitutional symptoms.

Pathological Changes Caused by Freeing the Ureters.

In the consideration of the above the ureter is not the only part concerned, but of still greater importance is the integrity of the kidney, whose function is dependent on an intact ureter, and also the effect of the escape of urine sterile or infected into the retroperitoneal tissue or into the general peritoneal cavity, should a ureteral fistula form as the result of the injury.

Conclusions based on anatomical studies, animal experimentation and the review of cases reported in the literature, justify one in saying that many liberties may be taken with the ureter, but that injury to its outer perimuscular fibrous coat, in which is situated the periureteral arterial plexus, is likely to cause ureteral necrosis.

The basis of this work is formed for the most part from experiments on dogs, but in a few instances I have been able to study the ureters of patients who have died after operations in which the ureters have been freed. The blood-supply of a dog's ureter is very similar to that of the human being, so experiments may be done simulating the various steps in operations involving the ureter, and the results of these experiments may be studied at different stages in the process of ureteral necrosis. The final results of these experiments, i. e., whether necrosis occurred or not, have already been referred to in this article. I shall now describe the pathological changes taking place in the ureter itself as a result of interfering with its blood-supply, and also the changes in the other parts and organs affected by the injury.

One must consider two classes of cases; first, those in which necrosis does not occur; secondly, those in which it does take place.

I. Changes which Take Place when Necrosis Does not Occur.

These changes manifest themselves in disturbances in the circulation of the ureter and thus an impairment of its function; and secondly, in the results of adhesions forming about the ureter with the chance of causing a stricture of the ureter.

A. *Circulatory Disturbances, not Sufficient to cause Ureteral Necrosis.*

1. *Arterial.*—The first effect of injuring the outer coat of the ureter is a diminished blood-supply to that part of the ureter, but this may soon be compensated for by a hypertrophy of the smaller vessels of the plexus which have not been injured and necrosis may thus be avoided. Later on, as adhesions form newly-formed vessels arise in the adhesions, some

extending from the surrounding tissue to the ureter and others from the ureter into the surrounding tissue. See Figs. III, IV, and V.

2. *Venous.*—In freeing the ureter, veins are injured as well as arteries, and as there is a very free anastomosis of the deep ureteral veins, these may become greatly engorged, as shown in Fig. VI, from a patient dying on the fifth day from intestinal obstruction, following a radical operation for cancer of the uterus in which the ureter had been freed, with but very little injury to the ureteral vascular plexus.

The only effect of these circulatory disturbances of the ureter which can be appreciated is that the ureter becomes swollen—compare Figs. IV and V—and this may embarrass the kidney by offering resistance to the escape of urine from that organ.

B. *Effect of Adhesions Forming About the Ureter.*

The ureter may be kinked or the adhesions may form a stricture giving rise to partial or complete ureteral obstruction, just as intestinal obstruction may occur. I have seen such conditions result from experimental work on dogs, and Fig. VII represents a hydro-ureter as a result of adhesions formed around a freed ureter, the patient dying on the ninth day from renal infection of the opposite kidney.

II. Ureteral Necrosis.

Two distinct classes of cases must be considered; first, those in which a fistula does not form; secondly, those in which the ureter ruptures and there follows an escape of urine into the surrounding tissue.

1. *Ureteral Necrosis in which a Rupture Does not Occur.*

The first change which manifests itself is an extravasation of blood into the ureteral tissue between the epithelium lining the lumen and the muscular coats. This condition is associated with necrosis of the part and is probably dependent on the necrosis; in other words, the condition is that of a hemorrhagic infarction. See Fig. VIII. This may be localized or may involve the ureter for several centimeters, depending on the extent of the injury. As the condition progresses the infarcted area becomes more distinct, the center failing to take the hematoxylin stain, while about the periphery can be seen a deeply stained border caused by the fragmentation of nuclei and the proliferation of cells outside of these. Fig. IX. This condition causes a swelling of the ureteral tissue with a resulting narrowing of the ureteral lumen, so that at the junction of the necrotic and living portion of the ureter a stricture develops (Fig. X), giving rise to a hydro-ureter above (Fig. XI), while below the necrotic area the ureter becomes swollen and here one can see the compensatory hypertrophy of the smaller ureteral arteries. Compare Figs. XII and XIII. While this condition has been going on the ureter has become imbedded in adhesions which protect the ureter and help prevent a rupture, Figs. IX, X, and XIV. Later on, at the end of two or three weeks, newly-formed vessels begin to penetrate the necrotic portion of the ureter and convert it into fibrous tissue (Fig. XIV) or the central necrotic portion may slough with a complete loss of the mucosa and muscular coats, Fig. XV. The extent of the process depends on the extent of the injury; the inner coats are affected first, and the outer fibrous coat becomes hypertrophied and very resistant (Fig. IX) and soon newly formed vessels enter it from the surrounding tissue with which the ureter may come in contact (Figs. XIV and XV). These newly-formed vessels maintain the nourishment of the outer ureteral coats but the inner coats have already become necrotic, and while vessels may invade it, the mucosa and muscular tissue have already been destroyed and the ureter may be converted into a fibrous cord.

The effect on the kidney is that of a progressing ureteral stricture (See Figs. XVI, XVII, XVIII, XIX) with corresponding hydro-ureter, hydro-nephrosis, and destruction of renal tissue. In some cases when the injury is light the kidney may continue to function with a persistent ureteral stricture, while in others, the kidney may be thrown out of function by destruction of the ureter. Added to these changes is the danger of ascending renal infection.

2. *Ureteral Necrosis Leading to a Ureteral Fistula.*

Why does a fistula occur in some cases and not in others? The first portions of the ureter affected are the inner coats, and the outer perimuscular fibrous coat is the last part affected; while necrosis is occurring in the inner coats of the ureter, the outer coat is becoming imbedded in adhesions. If the necrosis is very extensive or there is anything to prevent the formation of adhesions, which splint and protect the ureter, or if the adhesions are insufficient, then a fistula is likely to form. When the injury is very extensive, then the ureter for a long distance may be destroyed and exist as a friable necrotic tube, which, unless firmly imbedded in adhesions, will permit of an extravasation of urine. On the other hand, if the necrosis is more localized and the necrotic area is not well protected by adhesions, then an aneurysmal dilatation will occur at this place, which is likely to rupture and give rise to a ureteral fistula. In Fig. XXII this aneurysmal dilatation due to localized necrosis is shown. The specimen was obtained from a patient who died six days after the operation, the cause of death not being determined at autopsy. It is impossible to state whether in this specimen the early condition of the process was that of a hemorrhagic infarction or that of an ulceration. Judging from experimental work, it probably began as an infarcted area.

The effect of the formation of a fistula depends upon whether it becomes encapsulated or finds an outlet, and also of the greatest importance, whether or not the urine becomes infected. When the opening is small there may be an extravasation of urine and a final healing of the fistula. I scraped a dog's ureter with a sharp knife until a fistula appeared. It was dropped back into the peritoneal cavity discharging urine from the fistula, yet when the dog was killed 53 days later, the only trace of the injury was that the ureter was imbedded

in adhesions at this place. On the other hand, the injury may be more extensive, with loss of ureteral tissue, and if the urine becomes encapsulated, as shown in Fig. XX, the ultimate result is throwing the kidney out of function by destruction of the ureter. The extravasated urine may become infected and escape into the peritoneal cavity, giving rise to general peritonitis, as occurred in one dog; or may lead to renal infection; or, as shown in Fig. XXI, the urine may become encapsulated, then infected, and by direct extension up along the ureter a paranephritic abscess may be formed. Another possibility is that the urine may find an outlet, and *the formation of a uretero-vaginal fistula is the usual indication of post-operative ureteral necrosis.*

Etiological Factors in the Causation of Ureteral Necrosis.

These may be:

1. Injury to the periureteral arterial plexus.
2. Injury or ligation of the ureteral arteries themselves, or arteries which furnish these vessels.
3. Anything interfering with the formation of adhesions about the ureter, which splint and protect the ureter, and through which vessels may come to the ureter; as,
   (a) An infection.
   (b) An exudate.
   (c) Foreign bodies, as gauze, etc., separating the ureter from the surrounding tissue.
   (d) Necrosis of the tissue with which the ureter comes in contact, as might result from the use of the cautery.
4. Stricture of the ureter below the injured area, thus distending the weakened ureter.

When the uterine artery is tied at its origin, the ureteral vessels derived either directly or indirectly from this artery are destroyed; furthermore, if the ureter is dissected free, ureteral arteries coming from other vessels to that portion of the ureter are also destroyed, as from the vaginal, middle and inferior vesical arteries. By the above procedure the blood-supply of the lower 4-6 cm. of the ureter has been destroyed, except that coming from above through the periureteral arterial plexus, which we know is sufficient to prevent necrosis. If the ureter is handled roughly in shelling it out from its sheath, or from adherent cancerous tissue, there is danger of ureteral necrosis, for the smaller blood-vessels within the ureteral wall are too small and few in number (even if they do anastomose with each other?) to nourish the ureter but for a very short distance. It can readily be seen that an exudate or infection about the injured ureter would increase the liability of necrosis, as would also gauze, necrosis of the surrounding tissue, and anything interfering with the function of the ureter. To the above must be added the possibility of general lowered resistance.

Diagnosis of Ureteral Necrosis.

There are two distinct classes of cases which must be considered, one in which necrosis occurs but a fistula does not form, and a second in which the well-known tell-tale fistula arises.

In the first class of cases we are dealing with the gradual formation of a ureteral stricture, which may be temporary or permanent, and which may even lead to occlusion of the ureter. In the absence of infection, and if the patient recovers, this will probably never be diagnosticated unless a cystoscopic examination is made and the ureters are catheterized. Even if the patient dies, the injury could easily be overlooked. If renal infection occurs the diagnosis may be very difficult. I have had two patients die from ascending renal infection following these operations, one on the ninth and the other on the seventeenth day.[7] In one case, the ureters had been resected but not in the other. Both patients were free from pain and there were no symptoms referable to renal infection except the fever and constitutional symptoms associated with it. Even should urine escape, unless it manifests itself by escaping through the vagina or abdominal incision, its diagnosis would be very difficult, for it might become encapsulated, the kidney finally cease to function and the results would be similar to those cases in which the ureter became occluded. Should the urine form a mass which could be palpated in bimanual examination, then a diagnosis might be made; or should the injury lead to a hydronephrotic mass which could be palpated, then some injury to the ureter would be suspected. *The most important aid in diagnosing these injuries is keeping an accurate account of the amount of urine obtained from the bladder, which should be measured every 4 to 6 hours.* A sudden diminution in this amount, especially if associated with any constitutional disturbances, suggests that there may be some ureteral injury, and if marked enough would warrant a cystoscopic examination and catheterization of the ureters. *One must remember that the ureter may become completely occluded or a renal or pararenal infection may take place without a single localizing symptom.* While localized pain helps in such a diagnosis, the absence of such pain does not exclude such conditions. The appearance of urine through the vagina or abdominal incision makes clear the diagnosis of a ureteral or vesical fistula. I shall not go into the differential diagnosis between the two. The earliest day at which a ureteral fistula appeared in our cases was the ninth, and the latest the fifteenth. Wertheim [8] reports a case in which the escape of urine did not appear until after three weeks.

Prognosis of Ureteral Necrosis.

In those cases in which a fistula does not form, the ureter may recover with but little or no interference with its function. On the other hand, the injury may be sufficient to cause a temporary or permanent stricture, or even complete occlusion with corresponding renal insufficiency (Figs. XVI, XVII, XVIII and XIX). Associated with these changes is the danger of renal infection. Even when the ureter ruptures and an extravasation of urine occurs, the ureter may recover if the opening is small, as shown by this experiment. I scraped a dog's ureter at one place until an opening in the

ureter was made, and yet when the dog was killed, 53 days later, the ureter was pervious, and the same repair may take place in women, as shown by the spontaneous healing of those cases in which a fistula develops. When an extravasation of urine occurs and the ureteral injury is too extensive to heal, then undoubtedly the urine may be absorbed, the ureter occluded, and the kidney functionally destroyed. Of great danger in these cases is the chance for infection with the formation of a localized abscess or the possibility of an ascending renal infection. This infected urine may become localized or may spread, causing a general peritoneal infection, as occurred in one dog, or an ascending para-ureteral infection with the formation of a paranephritic abscess (Figs. XXI and XXIV).

Prognosis When a Uretero-Vaginal Fistula Forms.

This fistula may heal spontaneously, as two of our six cases did, one of which was double, thus making three fistulæ. In Case No. III the leakage ceased 32 days after its appearance, and in Case No. IV, 21 days; but in both instances ureteral stricture resulted with renal infection, as shown by catheterizing the ureters and making cultures from the urine from each kidney.

The fistula may persist for a long time. In Case I it persisted until death two months after its appearance, apparently from renal infection; while in Case II it persisted until "shortly before death," from a recurrence of the growth one year after the operation. The great danger associated with a ureteral fistula is that of ascending renal infection. This occurred in at least three of the five cases in which a fistula developed, *i. e.*, Cases I, III and IV, Case I probably dying as a result of renal infection.

Treatment of Ureteral Necrosis.

Unless a uretero-vaginal fistula forms the diagnosis is very difficult. Should the necrosis be bilateral and a fistula not form, then renal insufficiency might develop from partial or complete occlusion of the ureters. Catheterizing the ureters might not only make the diagnosis, but possibly temporarily relieve the condition. In some cases an exploratory laparotomy might be necessary in order to form a ureteral fistula or implant the ureters into the bladder should the condition of the patient permit it. If an extravasation of urine occurred and was diagnosed, it should be opened and drained.

What shall be done with the uretero-vaginal fistula? Some will heal spontaneously, but with stricture, and in many instances an ascending renal infection. Nephrectomy will cure not only the fistula but also the renal infection of that side. A surgeon can argue justly that an infected kidney with a strictured ureter is an organ dangerous to life and should be removed. There is one great drawback to nephrectomy in these cases, and that is the danger of renal insufficiency. For in the original operation both ureters had been freed, and while a fistula may have formed only in one, there is abundant opportunity for renal insufficiency of the other kidney resulting from partial or complete obstruction of its ureter, as a result of its having been freed at the previous operation. Nevertheless, one may find in the literature such cases cured by nephrectomy, and Wertheim[*] reports two such cases in a paper previously referred to in this article. Should one contemplate such treatment, the sufficiency of the other organ ought to be determined first.

Plastic operations, such as turning the fistula into the bladder through the vagina, will undoubtedly relieve some cases, but the renal infection and the stricture, both of which are probably present, especially the latter, are not likely to be relieved by such an operation, for the stricture is in most cases responsible for the maintenance of the renal infection.

Resection of the ureter and reimplantation into the bladder seem to me to offer the best chance of maintaining the renal sufficiency, relieving the stricture and curing the renal infection if present. This should be done extraperitoneally and the wound freely drained at the close of the operation. I realize that such an operation is very difficult, for the ureter is imbedded in scar tissue and there is great danger of ureteral necrosis occurring from dissecting the ureter from this tissue. Nevertheless, it saves a kidney, which is especially desirable when the other organ is likely to be insufficient. I did this in one case, No. VI, and ureteral necrosis probably occurred, but the patient was cured by a probable occlusion of the ureter, as has been described. Fortunately, the other kidney had escaped and was sufficient.

The Avoidance of Ureteral Necrosis.

Anatomical, experimental and clinical experience have taught us that many liberties may be taken with the ureter without causing necrosis. On the other hand, an injury to its outer loose perimuscular fibrous coat, which contains the periureteral arterial plexus, is likely to cause ureteral necrosis. This plexus may be injured by cutting off its blood-supply by the ligation of ureteral arteries or the larger vessels from which these arteries arise, as the uterine, anterior branch of the internal iliac, or the internal iliac artery itself. This injury alone probably never results in ureteral necrosis, for if *the plexus itself is uninjured* the ureter may be nourished from the renal artery alone. I have injected the entire ureter and portions of the bladder and uterus by injecting the renal artery alone, using a granular injection mass which could not pass through the capillaries, thus demonstrating that the entire injection was arterial and that an arterial communication existed between the bladder and the kidney through the ureteral arteries. Nevertheless, in all operations there should be as little injury to the blood-supply of the part as possible. Consequently, in these operations the ligation of the uterine artery alone is sufficient and attended with less danger than the ligation of the internal iliac artery or its anterior branch.

The most important etiological factor in the causation of injury to the periureteral arterial plexus is the actual injury to the plexus arising from handling the ureter roughly after it has been freed from the sheath which protects the ureter

and its plexus. When the ureter has been isolated and all vessels coming to that part have been cut off by freeing the ureter, that portion of the ureter freed must be nourished by vessels coming from above through the plexus, and if the plexus is injured in dissecting the ureter free, necrosis may occur.

Clinical experience and a study of the parametrium shows that the tissue about the ureters should be removed in these operations. Anatomical, experimental, and clinical studies demand that the periureteral arterial plexus must be preserved.

Two ways of preserving the periureteral arterial plexus present themselves: First, to dissect the ureter with its sheath free, thus preserving the arterial plexus; secondly, to resect the lower ends of the ureters and implant the renal ends of the ureters into the bladder. The dissection of the pelvic ureteral sheath free from its surrounding structures is difficult, for it is derived from these, as shown in a previous article;[3] likewise, the sheath frequently becomes involved in the extension of the growth, and while this procedure may be possible in the early cases it is attended with the danger of leaving disease behind in the more advanced ones, and unfortunately a positive diagnosis of cancer in the parametrium can only be made by the use of the microscope. On the other hand the ureter may be shelled out from this sheath and if great care is taken necrosis will not occur but if the plexus is sufficiently injured necrosis will take place, and of great importance a new sheath may be derived from the surrounding tissue.

The removal of all the tissue from pelvic wall to pelvic wall with the lower ends of the ureters offers the greatest chance for a cure, and at the same time the ureteral sheath and periureteral arterial plexus may be preserved, for the portion of the ureter which is above the parametrium lies beneath the peritoneum, and this peritoneal flap may be brought down and, with the ureteral sheath, sutured to the bladder. The suturing of the sheath and the peritoneum to the bladder relieves the tension of the implantation, and the periureteral arterial plexus is preserved and also the ureteral sheath. Against this procedure are the uncertainties of the uretero-vesical implantation and the danger of ascending renal infection. Careful work should minimize the chance of failure in the uretero-vesical implantation, and possibly the formation of a vesico-vaginal fistula at the close of the operation will lessen the danger of ascending renal infection, as discussed in previous articles.[2, 5 and 7]

Other accessory etiological factors in the causation of ureteral necrosis must be considered and avoided if possible. The presence of an exudate or infection will endanger the vitality of the injured periureteral arterial plexus, and on this account the area must be drained. On the other hand, the presence of gauze placed between the injured ureter and the surrounding tissue is a foreign body which deprives the ureter of any nourishment and support (splinting) which it may receive from this tissue with which it should come in contact. When the area is drained care must be taken not to have the drain come in contact with the ureter. The condition of the tissue which the ureter rests upon after freeing is most important, for if the vitality of this tissue is preserved the ureter will become adherent to it and will be nourished by it. On the other hand, if the vitality of this tissue is interfered with, then the ureter will not only be deprived of this nourishment but will lie in contact with necrotic tissue, which will predispose the ureter to necrosis. The following conditions interfere with the nourishment of this tissue:

1. The ligation of large vessels, as the internal iliac or its anterior branch, which are unnecessary.
2. The use of the cautery or cautery clamp, destroying this tissue.
3. Unnecessary mass ligatures.
4. Exudates and infection.

An avoidance of the above will greatly aid the preservation of the blood-supply of the ureter, no matter what the nature of injury or operation involving it.

Conclusions.

I. The ureter passes through tissue which should be removed in every instance of hysterectomy for carcinoma cervicis uteri; as shown by:

1. The large percentage of recurrences after hysterectomy for this disease; 88 per cent of the cases operated upon in this hospital, after a period of five years, showing recurrences (cases reviewed in October, 1902).
2. The renal insufficiency resulting from a compression of the ureters by the extension of the disease.
3. The accidental injury to the ureters in the operative treatment of the disease; 19 in 156 hysterectomies for carcinoma cervicis uteri, as compared with 11 instances of accidental ureteral injury in 4513 other major gynecological operations in this hospital.
4. The proximity of the cervix to the ureters and the relation between the two may be greatly altered under physiological conditions, by steps in operations and by pathological processes.
5. Kundrat has shown that the parametrium was involved in 44 of 80 operable cases, and that in half of these cases the parametrium was able to check the further progress of the disease.
6. A study of the parametrium in those cases in which the ureters have been resected shows that it takes but very little involvement by direct extension or metastases for the growth to reach or extend beyond the ureters and that the presence of this growth can be diagnosed only with the microscope, as I have emphasized in a previous article.[3]

II. The pelvic portion of the ureter lies in a sheath which protects the ureter and its periureteral arterial plexus and is derived from the tissue through which the ureter passes, and on this account the isolation of the ureter with the sheath is very difficult. On the other hand, the sheath may be split open and the ureter easily shelled out.

III. The effect of freeing the ureter from its sheath manifests itself in the opportunity for partial or complete ureteral obstruction resulting from the kinking or imbedding of the

ureter in adhesions (Fig. VII) and also in circulatory disturbances resulting from injury to the blood-supply of the ureter, which vary according to the severity of these disturbances and may present the following conditions:

1. Injuries to the larger branches of the ureteral plexus, where the smaller branches are able to enlarge and maintain the nourishment of the ureter, thus preventing necrosis (Figs. III, IV and V).

2. Venous congestion due to injury of the larger veins, causing distension of the deeper ureteral veins which anastomose freely with each other (Fig. VI).

3. Necrosis of the ureter which may or may not give rise to an extravasation of urine, depending on the extent of the injury and whether or not the ureter becomes imbedded in adhesions.

IV. Necrosis of the ureter apparently begins as a hemorrhagic infarct and the inner coats of the ureter are the parts first affected, while the outer perimuscular fibrous coat is the part last affected. In the early stages hemorrhage with necrosis is noticed first in the tissue beneath the epithelium (Fig. VIII). The size of the area involved and also the extent of the process depends on the severity of the circulatory disturbances. Later on the tissues in the infarcted area fail to take the hematoxylin stain, while about the periphery of this area is a deeply staining border, due to fragmentation of nuclei and proliferation of cells outside of these (Figs. IX and X). The outer fibrous ureteral coat becomes greatly thickened (Fig. IX) unless it also becomes necrotic.

V. Rupture of the ureter may not occur because the necrosis was not extensive enough, and also the ureter may become imbedded in adhesions which splint it and help nourish the outer ureteral coat by means of vessels coming in from the surrounding tissue (Figs. XIV and XV). The effect of necrosis is a stricture due to swelling caused by the necrotic tissue. This stricture may be temporary or permanent, depending on the severity of the process, or the necrosis of the ureter may be so extensive as to cause complete occlusion of the ureter with loss of function of the kidney (Figs. XVI, XVII, XVIII and XIX).

VI. Rupture of the ureter may occur, leading to an extravasation of urine, which may become encapsulated (Fig. XX), if infected lead to renal or pararenal infections (Fig. XXI) or other localized or diffuse infectious processes. When the urine finds an outlet through the vagina or abdominal incision a *ureteral fistula is formed which is the usual manifestation of ureteral necrosis.* The ureteral rupture is due to the extent of the necrosis, especially if the outer ureteral coat is involved, and the failure of the ureter to become imbedded in adhesions due to gauze, exudates, infection, or sloughing of surrounding tissue.

VII. Ureteral fistulæ may heal spontaneously, but probably always with a stricture and frequently with renal infection, which may cause the death of the individual. Frequently they persist over long periods of time with all the discomforts and dangers associated with this condition. In some cases they may close, with occlusion of the ureter and a loss of function of the kidney.

VIII. The most important etiological factor in the causation of ureteral necrosis is injury to the periureteral arterial plexus, arising from tearing or otherwise injuring the plexus, as may occur in dissecting the ureter free. Other etiological factors must be considered, as the ligation of vessels supplying the plexus, exudates, infection, destruction of tissue about the ureter, as would result from the use of the cautery, foreign bodies against the ureter (as gauze), pressure on the ureter, stricture below the injury, and lowered general resistance.

IX. Dissecting the ureter free from its sheath in these operations is attended with danger of interfering with the function of the ureter and of causing ureteral necrosis, and should be avoided when possible and if done great care should be taken not to injure the periureteral arterial plexus.

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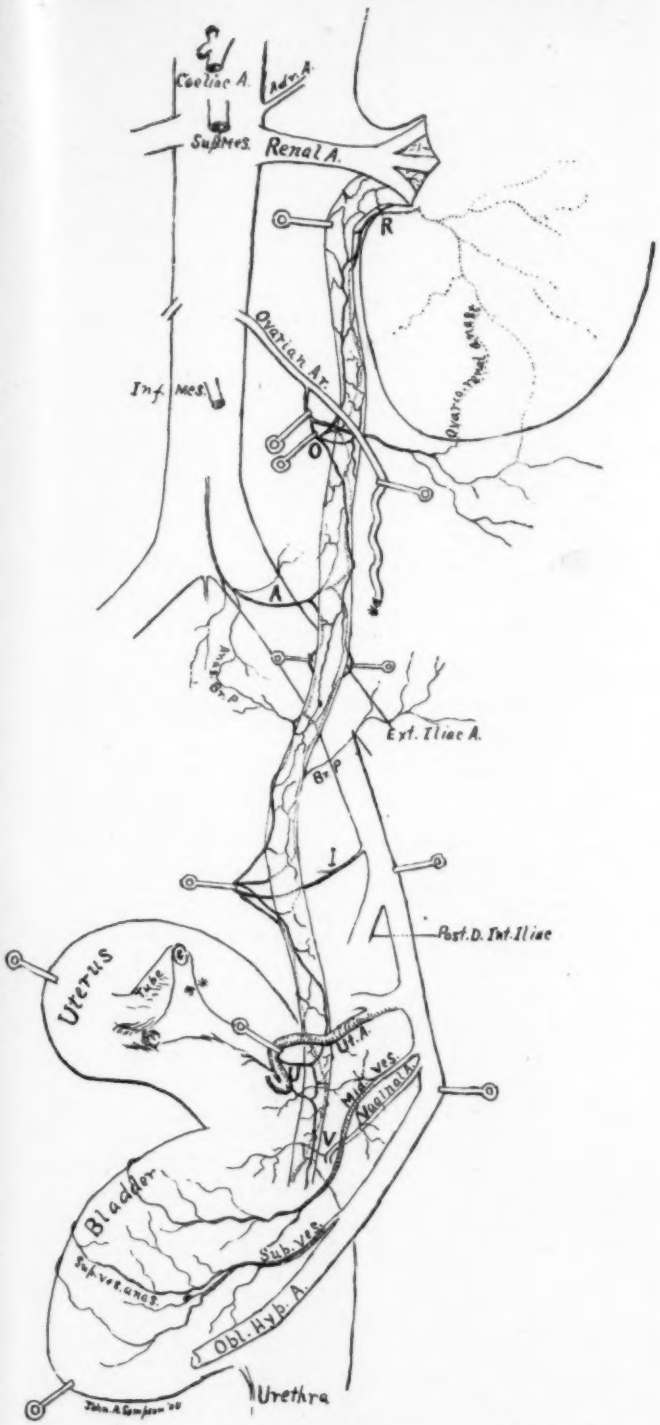


FIG. I.—THE PERIURETERAL ARTERIAL PLEXUS FROM A WOMAN 21 YEARS OLD, × 4/5. LEFT URETER.

The left renal and right internal iliac arteries were injected with a 15 per cent solution of gelatine, colored with ultramarine blue. The organs were removed and hardened in 10 per cent formalin. The drawing was made from the dissected hardened specimen.

The periureteral arterial plexus in this instance is derived from branches of the aorta, renal, ovarian, internal iliac, uterine, and vaginal arteries, marked, A, R, O, I, U, and V.

Uterus drawn upwards and to the right, the tube and ovary have been removed.

Contracted bladder, drawn downwards and to the right.

Ovario-Renal Anast. Anastomosis between the subperitoneal branches of the uretero-subperitoneal arteries, arising from the renal and ovarian arteries.

* * Anastomosis between the uterine and ovarian arteries, cut away by the removal of the tube and ovary.

Br. P. Branch from the periureteral arterial plexus, supplying the tissue about the ureter.

Anas. Br. P. Anastomosis between the subperitoneal branch of the aortic uretero-subperitoneal artery, and a branch arising from the plexus.

Sup. Ves. Anas. Anastomosis of the superior vesical artery of one side with the superior vesical artery of the other side.

FIG. II.—CROSS SECTION OF URETER, SHOWING THE PERIURETERAL ARTERIAL PLEXUS, AND THE URETERAL SHEATH, IN A WOMAN, 21 YEARS OLD, × 5. RIGHT URETER.

The left renal and the right internal iliac arteries were injected with a 15 per cent solution of gelatine, colored with ultramarine blue. The organs were removed and hardened in 10 per cent formalin. The drawing was made from a cross section of the right ureter taken about 15 cm. above the uterus. Same case as one from which Fig. I was made.

For the sake of clearness, only the ureteral arteries are drawn, as injected. The capillaries and the veins were not injected. The periureteral arterial plexus, situated within the ureteral sheath, can be seen cut across as well as the small arteries in the walls of the ureter. This sheath is apparently derived from the pelvic connective tissue and serves as a protection to the ureter and its periureteral arterial plexus. The arteries in the ureteral walls are small in size and number and on this account, even should they communicate freely with each other, would not be able to nourish the ureter for any great distance if the periureteral arterial plexus was destroyed.

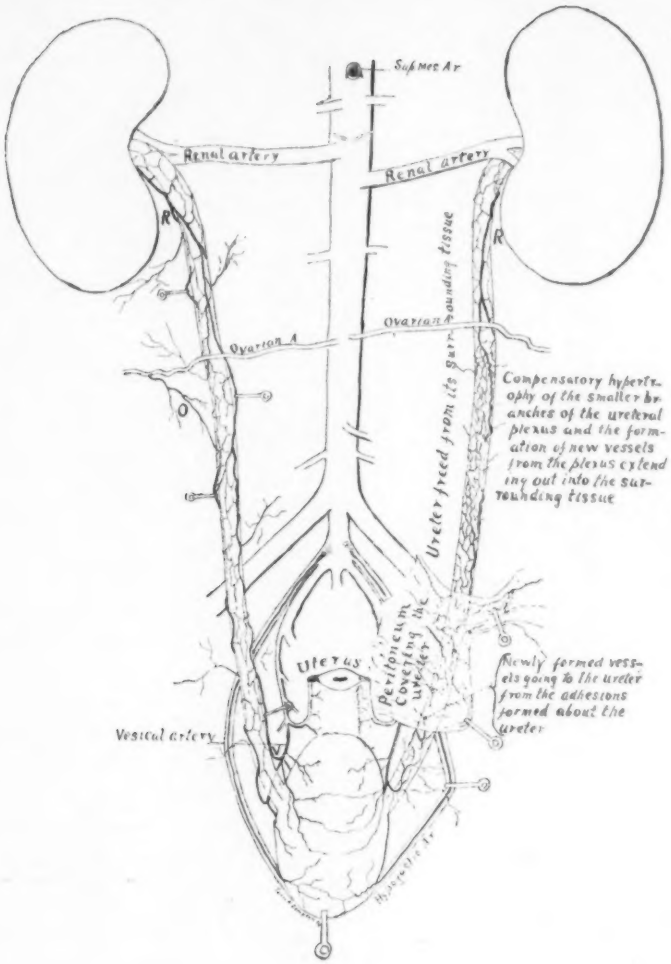

Renal artery
Renal artery
R
R
Ovarian A
Ovarian
Compensatory hypertrophy of the smaller branches of the ureteral plexus and the formation of new vessels from the plexus extending out into the surrounding tissue
Ureter freed from its surrounding tissue
Uterus
Peritoneum covering the ureter
Newly formed vessels going to the ureter from the adhesions formed about the ureter
Vesical artery

FIG. III.—RESTORATION OF THE BLOOD SUPPLY OF THE URETER FOLLOWING INJURY TO ITS PERIURETERAL ARTERIAL PLEXUS. DOG NO. 1, × 1.

Portions of the arterial plexus of the lower two-thirds of the left ureter were torn off with forceps, injuring the main trunks of the pelvis.

The dog was killed at the end of two weeks and the descending aorta was injected with 15 per cent gelatine, colored with ultramarine blue.

The ureter of the dog is nourished by a periureteral arterial plexus similar to that found in human beings, the main trunks being more loosely attached to the ureter than its smaller branches and are therefore more easily injured.

Following injury the ureter becomes imbedded in adhesions and there is a hypertrophy of the smaller branches which have escaped injury and likewise new vessels arise from the ureter and from the newly-formed adhesions about the ureter.

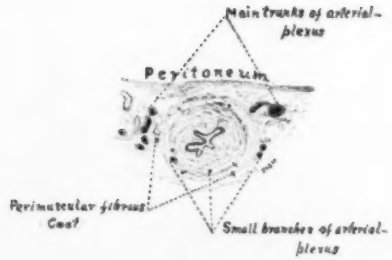


FIG. IV.—CROSS SECTION OF A DOG'S URETER, SHOWING THE RELATION BETWEEN THE MAIN TRUNKS OF THE PERIURETERAL ARTERIAL PLEXUS AND THEIR SMALLER BRANCHES. DOG, NO. 9, × 8.

The left ureter of a dog was freed for nearly its entire length and portions of the arterial plexus were stripped off. The dog was killed at the end of two weeks and the descending aorta was injected with 15 per cent gelatine, colored with ultramarine blue.

This illustration is from the uninjured ureter and shows that the main trunks of the plexus are but loosely attached to the ureter, while the smaller branches are more deeply imbedded in the outer perimuscular fibrous coat of the ureter, and on this account it is difficult to injure them. Note the small size and number of the deeper ureteral arteries, for ultramarine blue being granular does not enter the capillaries.

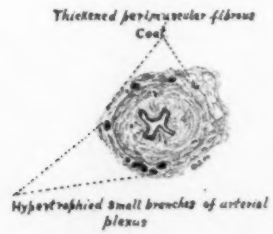


FIG. V.—CROSS SECTION OF A DOG'S URETER, SHOWING THE COMPENSATORY HYPERTROPHY OF THE SMALLER BRANCHES OF THE ARTERIAL PLEXUS FOLLOWING INJURY TO ITS LARGER TRUNKS. DOG NO. 9, × 8.

From same dog as illustrated in Fig. IV. Cross section of injured ureter. The main trunks of the arterial plexus, shown in Fig. IV, have been stripped off from the ureter, but the smaller branches, also shown in Fig. IV, being imbedded in the outer perimuscular fibrous coat of the ureter, escaped injury and have become hypertrophied, thus maintaining the nourishment of the ureter. The ureter itself has become thickened.

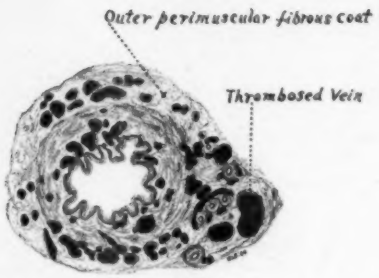


FIG. VI.—CROSS SECTION OF A URETER WHICH HAS BEEN FREED IN THE MORE RADICAL OPERATION FOR CARCINOMA CERVICIS UTERI, SHOWING THE PASSIVE CONGESTION DUE TO INJURY OF THE LARGER VEINS. GYN. NO. 10,494. GYN. PATH. NO. 6715, × 6.

Patient died on the 5th day from intestinal obstruction. The lower portion of the ureters had been freed in the operation and this specimen was obtained from the freed portion of the right ureter.

There is a free anastomosis of the deeper ureteral veins and when the outer main trunks are injured these deeper veins become engorged, as shown in the drawing, probably interfering somewhat with the function of the ureter, and thus possibly the passage of urine from the kidney to the bladder.

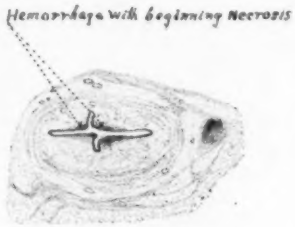


FIG. VIII.—CROSS SECTION OF DOG'S URETER, SHOWING BEGINNING NECROSIS AS THE RESULT OF INJURY TO THE PERIURETERAL ARTERIAL PLEXUS. DOG NO. 22, × 8.

The left ureter of a dog was freed for 4 cm. and then the periureteral arterial plexus was removed and the ureter scraped on all sides for a distance of 2 cm., thus not only destroying the main trunks of the arterial plexus, but also injuring the smaller branches which are more adherent to the ureter (see Fig. IV). The dog was killed in two days.

The necrosis manifests itself as a necrosis with hemorrhage into the tissues just beneath the epithelium.

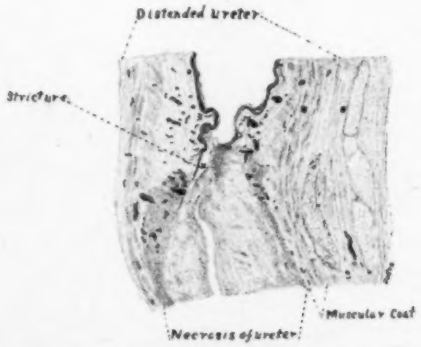


FIG. X.—LONGITUDINAL SECTION OF A DOG'S URETER AT THE JUNCTION OF A NECROTIC WITH AN INTACT PORTION. DOG NO. 5, × 8.

One can see how the necrosis begins in the inner coats of the ureter and leads to swelling with stricture, causing hydroureter above, and below presenting the picture shown in Fig. XII. Compare this drawing with the one shown in Fig. XIII, which is the normal ureter from the same dog.

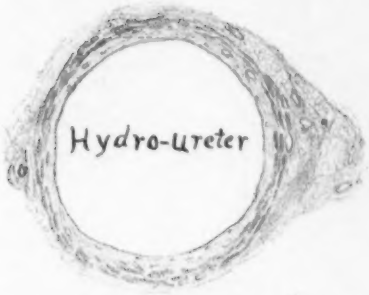


FIG. VII.—HYDROURETER RESULTING FROM FREEING THE URETERS IN THE MORE RADICAL OPERATIONS FOR CARCINOMA CERVICIS UTERI, THUS DEPRIVING THE URETER OF ITS SHEATH AND RENDERING IT LIABLE TO PARTIAL OR COMPLETE URETERAL OBSTRUCTION FROM ITS BECOMING IMBEDDED IN ADHESIONS. GYN. NO. 10,432, × 6.

Patient died on the ninth day from ascending renal infection of the right kidney. The left ureter, where it had been freed, was imbedded in adhesions, giving rise to a hydroureter above.

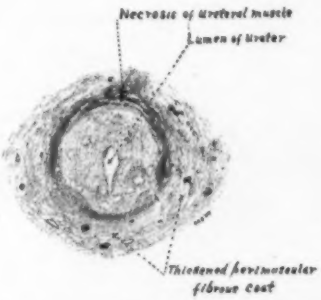


FIG. IX.—CROSS SECTION OF A DOG'S URETER, SHOWING NECROSIS OF ALL THE URETERAL COATS EXCEPT THE OUTER PERIMUSCULAR FIBROUS COAT. DOG NO. 5, × 8.

The lower portion of the ureter was freed and portions of the arterial plexus were removed with forceps.

The dog was killed at the end of one week and the descending aorta was injected with 15 per cent gelatine, colored with ultramarine blue. The ureter had become necrotic for a distance of 2 cm. This represents a section through the necrotic area, showing that the outer fibrous coats had escaped. The inner coats present the picture of a hemorrhagic infarction, the epithelium has disappeared and the central portion fails to take the hematoxylin stain, while about this is a deeply staining border caused by the fragmentation of nuclei and proliferation of cells.

FIG. XI.—CROSS SECTION OF HYDROURETER CAUSED BY STRICTURE BELOW, DUE TO URETERAL NECROSIS. DOG NO. 5, × 8.

Same dog as shown in Figs. IV and V.

Section taken above the stricture shown in Fig. X, showing the distension of the ureter caused by the necrosis below.

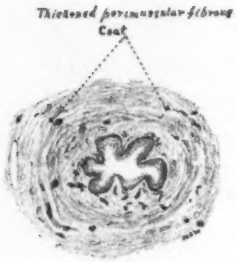


FIG. XII.—CROSS SECTION OF URETER BELOW NECROTIC PORTION, SHOWING DISTENTION AND HYPERTROPHY OF DEEPER URETERAL VESSELS. DOG NO. 5, × 8.

Section taken just below necrotic area shown in Fig. X.

The ureter is much swollen and the deeper ureteral arteries are hypertrophied and distended, due to injury of the arterial plexus. Compare with Fig. XIII, which represents a cross section of the normal ureter from the same dog.

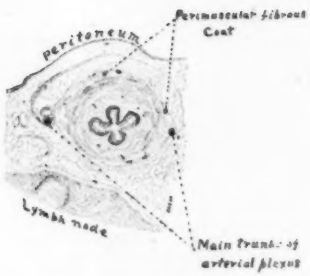


FIG. XIII.—CROSS SECTION OF DOG'S URETER, SHOWING NORMAL ARTERIAL BLOOD SUPPLY. DOG NO. 5, × 8

Normal ureter from same dog as illustrations shown in Figs. IX, X, XI and XII, with which compare, noticing the difference in the size of the deeper blood-vessels and of the diameter of the ureter in the injured and intact ureter.

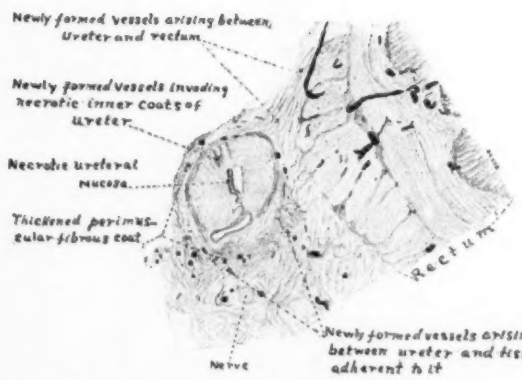

Newly formed vessels arising between Ureter and rectum
Newly formed vessels invading necrotic inner coats of ureter
Necrotic ureteral mucosa
Thickened perimuscular fibrous coat
Rectum
Newly formed vessels arising between ureter and tissue adherent to it
Nerve

FIG. XIV.—CROSS SECTION OF DOG'S URETER, SHOWING NECROSIS OF INNER COATS, WITH NEWLY FORMED VESSELS INVADING THE NECROTIC TISSUE. DOG NO. 7, × 8.

Larger vessels of ureteral plexus were stripped from the left ureter and both uterine arteries were ligated.

Dog was killed in three weeks and descending aorta was injected with 15 per cent gelatine, colored with ultramarine blue. Result: ureteral necrosis with stricture and hydroureter and hydronephrosis (see Fig. XIX). The outer fibrous coat of the ureter has lived and newly-formed vessels can be seen entering it from the surrounding tissue, for the ureter became adherent to the rectum.

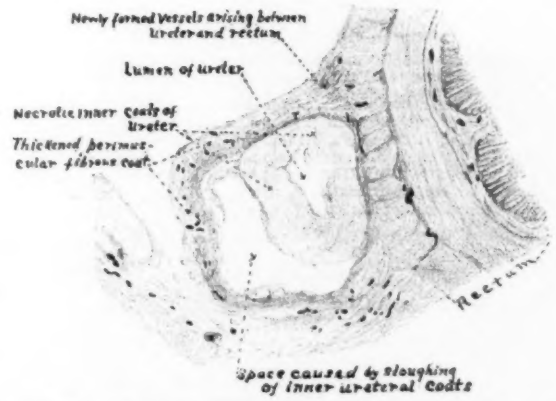

Newly formed vessels arising between ureter and rectum
Lumen of ureter
Necrotic inner coats of ureter
Thickened perimuscular fibrous coat
Rectum
Space caused by sloughing of inner ureteral coats

FIG. XV.—SECTION TAKEN JUST ABOVE THE ONE SHOWN IN FIG. XIV. (SEE ALSO FIG. XIX.)

Shows the preservation of the outer perimuscular fibrous coat, and also the sloughing of the inner ones which had become necrotic.

FIG. XVI.—SEMI-DIAGRAMMATIC REPRESENTATION OF THE EFFECT OF URETERAL NECROSIS ON THE URETER AND KIDNEY. DOG NO. 19, × 1.

The left ureter was stripped from its surrounding tissue for a distance of 4 cm. and scraped with a sharp knife. The dog was killed in four days and necrosis of the inner and portions of all the ureteral coats had occurred, causing swelling of the ureter with stricture formation and beginning hydroureter above. The necrotic portion is represented by the shaded lines and this portion of the ureter has become imbedded in adhesions.

FIG. XVII.—AS IN FIG. XVI. DOG NO. 17, × 1.

The periureteral arterial plexus was injured by stripping portions of it off for the lower one-half of the ureter; the vesical arteries were tied, which complete the lower end of the ureteral plexus. The dog was killed at the end of one week. One sees a later stage of the effect of the necrosis shown in Fig. XVI. The ureter has become almost occluded with hydroureter above and beginning hydronephrosis, and also the ureter is more tortuous. Sections IX, X, XI and XII, while from another case, represent very well the changes shown in this drawing.

FIG. XVIII.—AS IN FIGS. XVI AND XVII. LATER CONDITION. DOG NO. 16, × 1.

The periureteral arterial plexus was injured by stripping portions of it away from the lower part of the left ureter, and the vessels were tied which complete the lower end of the ureteral plexus on both sides. The dog was killed at the end of three weeks. One sees a later stage of the effects of necrosis shown in the previous illustration. The hydroureter and hydronephrosis is more marked, as well as the tortuosity of the ureter.

FIG. XIX.—SPECIMEN FROM WHICH ILLUSTRATIONS XIV AND XV WERE MADE. DOG NO. 7, × 8.

The ureter has become greatly distended and very tortuous, the pelvis of the kidney has become markedly distended, with loss of kidney tissue.

The necrotic ureter has become adherent to the rectum and is splinted and nourished by it. The inner coats of ureter are necrotic and in places are separating, as a slough from the outer fibrous coat (see Fig. XV). The ureter was occluded and the kidney thrown out of function.

An extravasation of urine did not occur, due to the fact that the outer fibrous coat did not become necrotic and was nourished by the surrounding tissue.

FIG. XX.—SEMI-DIAGRAMMATIC REPRESENTATION OF THE EFFECT OF URETERAL NECROSIS WHERE AN EXTRAVASATION OF URINE OCCURRED WHICH BECAME ENCAPSULATED. DOG NO. 8, × 1.

Experiment similar to the one illustrated in Fig. XIX. In the former instance the ureter became imbedded in adhesions and an extravasation of urine did not occur. In this instance the necrosis was so extensive and the adhesions were so slight that a rupture was not prevented. The urine became encapsulated, the rectum forming the mesial wall of the sac and the thickened peritoneum the rest of the sac. Hydroureter and hydronephrosis resulted from this and probably the urine would eventually have been absorbed, the ureter occluded, and the kidney ceased to function.

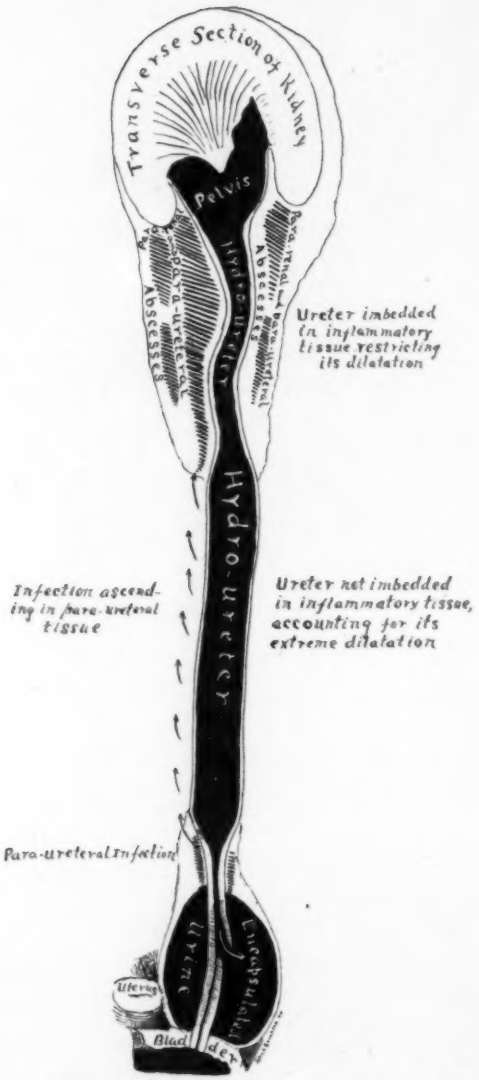


FIG. XXI.—SEMI-DIAGRAMMATIC REPRESENTATION OF AN ASCENDING PARAURETERAL AND PARARENAL INFECTION, FROM AN EXTRAVASATION OF URINE. DOG NO. 26, × 1.

Same cases as represented in Fig. XXIV. The ureter ruptured, the urine escaped, then became encapsulated and infected.

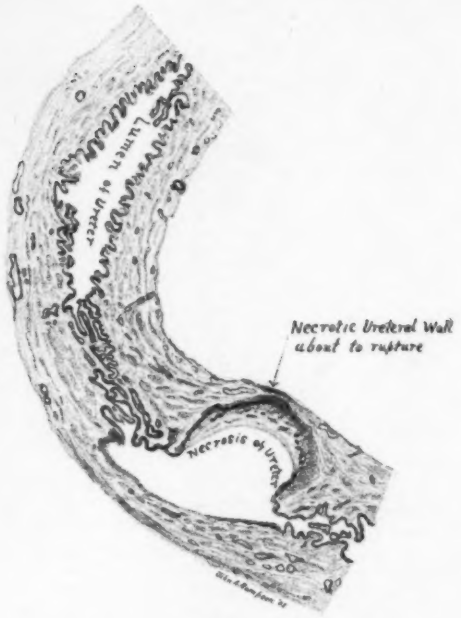


FIG. XXII.—LOCALIZED NECROSIS OF URETER ABOUT TO RUPTURE, FOLLOWING FREEING OF THE URETER IN THE MORE RADICAL OPERATIONS FOR CARCINOMA CERVICIS UTERI. GYN. NO. 10,084, × 4.

Ureters had been freed. Patient died on the 6th day. Cause of death was not determined. Longitudinal section of right ureter. It is impossible to say whether this began as a localized ulceration or hemorrhagic infarction; judging by animal experimentation it was the latter.

FIG. XXIII.—CROSS SECTION OF URETER WHERE ASCENDING RENAL INFECTION HAS OCCURRED FOLLOWING THE FREEING OF THE URETERS IN THE MORE RADICAL OPERATIONS FOR CARCINOMA CERVICIS UTERI. GYN. NO. 10,432, × 4.

Same case as one represented in Fig. VII, but opposite ureter.

The cystitis had extended through the bladder wall and had involved the ureter and extended up it; this might cause necrosis.

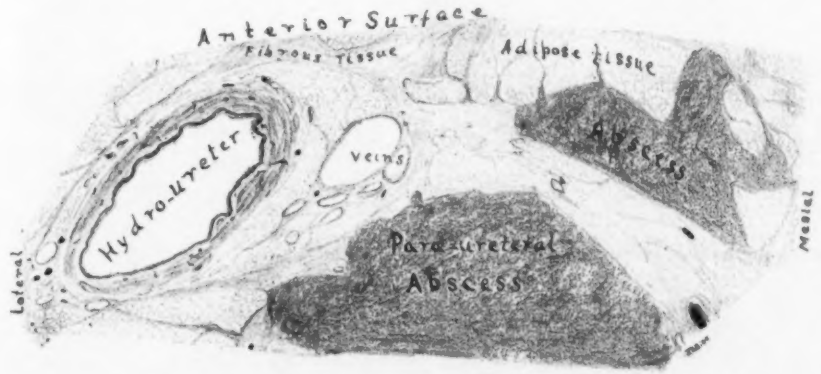


FIG. XXIV.—SHOWS THE RELATION OF AN ASCENDING PARAURETERAL INFECTION TO THE URETER. DOG. NO. 26, × 8.

Left ureter of a dog was scraped on all sides for a distance of 2 cm., thus injuring not only the larger vessels of the arterial plexus but also the smaller branches.

The dog was killed in six days and necrosis with rupture was found. The urine became encapsulated, then infected, and an ascending paraureteral infection occurred, also giving rise to a pararenal infection (see Fig. XXI).

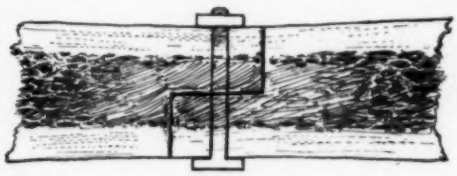
THE SILVER BOLT AS A MEANS OF FIXING UNUNITED FRACTURES OF CERTAIN LONG BONES.

By Stephen H. Watts, M. D.,

Assistant Resident Surgeon, The Johns Hopkins Hospital.

Doubtless everyone, who has had much to do with ununited fractures, realizes how unsatisfactory they are to deal with, and how uncertain are the mechanical means employed to fix them. Numerous methods have been recommended: silver wire, nails, screws, plates, hooks, ivory pegs, bony rings and other more complicated apparatus. Most of these methods will not hold the fragments in good apposition if they tend to become displaced.

About two years ago I was present at an operation for ununited fracture of the shaft of the femur. The fragments had been mortised together and wired, the wound in the soft parts then being closed. As the plaster cast was about to be applied, a snap was heard and the wire was found to be broken. The wiring had to be repeated. At that time it occurred to me that a silver bolt, substituted for the wire, would not only hold the fragments much more securely, but in much better apposition. I had some bolts made and a few months ago we used one of them in a case of ununited fracture of the shaft of the femur, near the junction of its middle and upper thirds.



The patient, a man 32 years of age, was brought to the hospital on June 24, 1903, with the history of having been injured in a stone quarry some hours previously. On examination he was found to have a very bad compound, comminuted fracture of both bones of the right lower leg and a compound fracture of the left femur, the skin opening over the site of fracture being quite small. This wound was thoroughly cleaned and a plaster cast applied. An attempt was made to save the right leg also, but five days later it became necessary to amputate it just above the knee. The fractured left femur was treated in plaster until August 7, 1903, when, no union being present, and considerable overriding of the fragments being discovered, the casts were discontinued and Buck's extension applied. The small wound in the soft parts had healed some time before.

On August 21, 1903, two months after the injury, no union having taken place, the limb was operated upon. The ends of the fragments, which overlapped several centimeters, lay in a definite sac filled with clear fluid; evidently an early stage in the formation of a false joint. The sac was excised, the bones mortised step-wise, care being taken to preserve as much periosteum as possible, and the silver bolt inserted in an antero-posterior direction as shown in the accompanying diagram. The nut was screwed down and the projecting portion of the bolt cut off. The fragments were thus held firmly in excellent position. The skin wound was sutured with silver wire, a very small drain of rubber tissue being placed down to the site of the fracture. In this case the mortise was so made

that the projecting portion of the lower fragment lay anterior to, and thus rested upon, the projecting portion of the upper fragment. This arrangement is of some importance, as it removes from the bolt a large part of the weight of the leg and counteracts the tendency of the upper fragment to become flexed. At the first dressing, which was made about two weeks after the operation, the wound was found to be very clean and the fragments of bone in good position. The skin suture and drain were removed and the cast reapplied. After this, new casts were applied at intervals of 3-4 weeks, the

wound having been found perfectly healed at the time of the second dressing.

On Dec. 4, 1903, about three months after the operation, it was interesting to note that, whereas a few degrees of lateral motion was possible at the site of fracture, no motion was possible in an antero-posterior direction, namely, in the direction of the shaft of the bolt. On January 10, 1904, the fracture was found to be perfectly solid, no further retentive apparatus being necessary. The patient was very persistent in his efforts to limber up the knee and succeeded wonderfully well. In a very short time he was able to walk on crutches. When he left the hospital his only encumbrance was a poorly-fitting artificial leg on the opposite side. The skiagram, which was taken about five months after the operation, shows the bolt in situ.

In the above case we used a bolt whose shaft was 1 5-8 inches long by 3-32 inch in diameter and whose head was 1-4 inch square by 3-32 inch in thickness. This is a very convenient size and can be used for any part of the shaft of the femur or humerus. For the latter a slightly smaller bolt would be preferable. They can be made by almost any jeweler or instrument maker.

This method is by no means perfect, but was used for want of a better one. It seems chiefly applicable to fractures of the shaft of the femur or humerus and certain oblique fractures of the tibia. Its great advantage is that it apposes the fragments better and holds them thus more securely than perhaps any other method with which I am acquainted.

It has many disadvantages in common with most other mechanical methods of the same general nature. Some of these are:

1. That a foreign body is left in the bone, which may prove a source of irritation and require removal at some subsequent period. With careful technique, I believe this would practically never be necessary. We find that buried silver sutures, even in infected wounds, rarely cause trouble.

2. That the limb is considerably shortened. The shortening, however, is usually a minor consideration as compared with a good useful member, and, as a matter of fact, in a large number of cases of ununited fracture, there is some overriding of the fragments which cannot be overcome, and of which advantage may be taken to secure good apposition.

3. That the bone is weakened by the introduction of the bolt. If this be true, the same objection might be raised to many of the methods now used, in which a foreign body is left in the bone. Most likely there is some compensatory enlargement of the bone at this point.

EXHIBITION OF FOUR APPENDICES VERMIFORMES SHOWING UNUSUAL PATHOLOGICAL CONDITIONS (FROM THE SERVICE OF DR. KELLY).[1]

By C. F. Burnam, M. D.,

Assistant Resident in Gynecology, The Johns Hopkins Hospital.

During the past summer four especially interesting appendices have been received at the pathological laboratory of the gynecological department of the hospital. The rarity of the conditions presented is sufficient to make the specimens interesting in themselves, but this interest is greatly added to by a consideration of the clinical facts obtained by inquiry from and observation of the patients from whom the specimens were obtained. I propose, therefore, to give a résumé of the clinical and pathological findings of each case and then to add such conclusions or suggestions as these facts seem to warrant. The group of cases includes one of actinomycosis, one of carcinoma and two of tuberculosis. Two of the cases occurred in the service of the hospital and two were private patients of Dr. Thomas S. Cullen, to whom, and to Dr. Kelly, I desire here to express my thanks for permission to report the series.

Case 1.—Primary Actinomycosis of Appendix. (Gyn.-Path. No. 6961.) Catherine P., bl., æt. 28. Service of Dr. Kelly.

Clinical History:

Past History.—Always well and strong. Has spent most of life on a farm in North Carolina.

Menstrual History.—Regular, q. m. Duration 4 days. Last period just ended on admission.

Marital History.—Two Para, 3 and 2 years. A miscarriage in September, 1902.

Present Illness.—Its onset was in December, 1902, with intense colicky pain in the right lower part of the abdomen. Previous to this there had been no diarrhea or blood in the stools or any symptoms indicating disease of the intestines. This pain lasted a few weeks, but at the end of a week the patient noted at the site of McBurney's point a "swelling the size of a hen's egg." From this point the swelling continued gradually spreading until at the time of her admission to the hospital, May 27, 1903, almost the entire abdomen below the umbilicus was involved. A week prior to her admission a small sinus had opened in the vicinity of the umbilicus and was discharging a purulent-like material. Patient had night sweats and had lost in weight and in strength.

Physical Examination.—On admission patient was noted to be a fairly well-nourished mulatto woman. The lungs and heart on physical examination were normal. No enlargement of the superficial lymph glands was present. Above the umbilicus the abdomen looked normal and on palpation was soft

[1] Presented to the Johns Hopkins Hospital Medical Society, November 2, 1903.

and not tender. The lower part of the abdomen was protuberant and around the umbilicus red-looking. On palpation it was densely hard and gave the same impression as an intramural abscess.

Owing to the thickness and rigidity of the abdominal wall the pelvic examination was found to be quite indefinite. The temperature was irregularly remittent, higher in the afternoon than in the morning. In the beginning it rarely went to 102°. The leucocyte count made at this time was 12,000.

Treatment and Course.—On May 29 a median incision made from umbilicus to symphysis opened a large cavity lying anterior to the recti muscles and containing a necrotic material. The wall, composed of subcutaneous fat and muscle, presented a homogeneous, semi-translucent appearance, being similar to that seen in an omentum infiltrated with carcinoma. Microscopic examination showed in the tissue from the wall the ray-fungus. Healing hardly took place at all, although the temperature went to normal. About the middle of June the patient began to take potassium iodide by mouth and an ointment of the same was applied locally. On June 27 the median incision was again opened and parallel incisions were made along the recti muscles. These incisions were connected by cross-incisions. It was noted that the muscles and all the tissues down to the peritoneum were infiltrated. From this time the induration began to disappear and the incisions to heal, and at the time of death the abdominal wall was almost normal. Improvement continued until July 24, when a pain began in the right lower thoracic region. This onset of pain was accompanied by fever. On August 9, after a chill, the temperature, which had been of an intermittent type, rose to 106°. The leucocytes then counted numbered 5800. The liver dulness was greatly increased and marked tenderness was present over it. A few days before death, August 27, râles, dulness on percussion and other signs of lung involvement, set in. The sputum examined for the ray-fungus did not show it.

Findings at Autopsy.—The abdominal wall, save for scar tissue, was almost normal. The omentum was adherent to the line of incisions along the abdominal wall. A few adhesions were present between the sigmoid and the uterus. The superior surface of the liver was adherent to the diaphragm and in freeing it an abscess in the right lobe of the liver 8 cm. in diameter was entered. A number of smaller abscesses were present in the substance of the liver. An area of softening and necrosis was present in the spleen. Besides these lesions the abdominal viscera were normal save in the region of the ileo-cecal-appendical junction. The lungs were studded with yellowish opaque areas. The pleural cavities contained fluid encysted between layers of adhesions. The brain was not examined. Microscopical examination of these various lesions showed that they were those of actinomycosis.

The appendix lay behind the cecum and ileum. It was not so much a retrocecal appendix as a retro-ileac appendix. It was so densely buried in adhesions as to be discovered with difficulty, and only came clearly to light after dissecting back these adhesions. In doing this several small abscesses were discovered in the adhesions between the ileum and appendix and between the cecum and appendix. The appendix measured about 4.5 cm. in length and 1.3 cm. at base in cross diameter and 1 cm. near apex in cross diameter. On opening the cecum it was found that the appendix pouted into it in an interesting way. On cross-sectioning, the lumen was found greatly narrowed even quite near the cecum. A section at the junction of the inner and middle thirds shows a complete obliteration of the lumen on microscopical examination. The cecal mucosa and wall seemed fairly normal. A section through the appendix quite near its cecal end and passing through one of the small abscesses described, showed a narrow lumen. A surface epithelium, mostly absent (apparently by manipulation); normal-looking crypts of Lieberkühn; a fairly normal interglandular substance, save that an unusual number of small round cells were present; a thickened submucosa, composed of a dense fibrous tissue containing very few nuclei and in which the blood-vessels ran longitudinally; an absence of the lymph follicles; between the submucosa and the circular muscle a small abscess not observed macroscopically containing pus cells and the fungus; a normal-appearing circular muscle coat; and a longitudinal muscle coat which, where present, seemed normal (it had been largely pulled off in the dissecting out of the appendix). The abscess noted macroscopically was in the adhesions but also extends into the muscle coat of the cecum a little way. It contained the ray-fungus in addition to pus cells. A section through the appendix at the junction of the cecal and the middle thirds showed an obliterated lumen. In its place was a granulation tissue. At almost the middle point was a small abscess containing, in addition to pus cells, a giant cell. The fungus was not present. The mucosa was entirely gone.

It may be added here that attempts in life were made to obtain a culture from the abdominal wall, but with negative results. The fungus, as it appeared in the tissue which had been hardened in formalin, cut in celloidin and stained with hæmatoxylin and eosin, showed the central network of threads but the clubs were not obtained.

Considered from the history of its onset and from its clinical course in conjunction with the pathological findings described, it can be definitely concluded that we had to deal with a primary actinomycosis of the appendix which had extended to and involved the anterior abdominal wall and had later metastasized to the liver, lungs, etc.

Among the points of interest clinically observed was the absence of leucocytosis with a high elevation of temperature. The count of 12,000 made on the patient's admission can be explained by a temporary secondary infection, as the abdominal wall abscess was in direct communication with the exterior.

As to the treatment, the observer was impressed that a great deal of real benefit was derived from the potassium iodide, which was given in doses as high as 4 grams t. i. d. by mouth and by an ointment which was rubbed into the abdomen. In this case the treatment which is universally agreed to be the proper one, i. e., the complete removal of the infected area,

was, on account of its tremendous extent, impossible. It is possible that if in July, after the abdominal infiltration had greatly subsided and the metastases not yet appeared, we had removed the appendix with the adjacent cecum and ileum, the patient might have recovered. Without an operation actinomycosis of the abdominal wall and intestinal tract is always fatal. Grill's collection gives some idea of operative results: Out of 111 cases, 45 died, 22 recovered, 10 were bettered and the remainder were yet under treatment or had been lost sight of at the time of his publication. Those interested in the potassium iodide treatment will find it excellently considered in Prutz's paper and in the monograph on actinomycosis of Poncet and Berard.

It would seem in our case that metastases had occurred through the blood. Bollinger was the first to show metastases by the lymphatics; later, Ponfick demonstrated the occurrence by the blood.

Hertz in 64 cases of intestinal actinomycosis finds that in all but two the infection had passed the mucosa without leaving a trace; in our case in part the mucosa and lumen of the appendix were both replaced by actinomycotic tissue.

It does not seem indicated to go into the history of the disease in this paper, interesting as such a consideration is. Nor is there anything in the case which adds to our knowledge of the actinomyces itself or the mode of its entrance into and infection of man. These subjects are considered in some of the papers referred to in the literature cited at the end of this paper, that of Poncet and Berard cited above being very good.

While a rare condition, actinomycosis primary in the appendix has been reported a number of times in the literature. This has been well shown by the monograph of Isemer, 1898, who collected 19 cases, and that of Spickenbaum, 1900, who collected 27 cases. Without attempting any further collection, I might add the cases of Ekehorn, 1900; Daske, 1902, Thevenot, 1902, and Letulle, 1903.

Case II.—Primary Carcinoma of Appendix. (Gyn.-Path. No. 6974.) Mr. ——. æt. 25. Private patient of Dr. Cullen.

Clinical Account:

Family History and *Past History* unimportant.

Present Illness.—For two years patient has had recurrent attacks of pain in the right lower quadrant of the abdomen. These attacks have been increasing in frequency and severity. An attack was subsiding at the time of the operation, October 4, 1903. There were pain and tenderness at McBurney's point and the temperature was slightly above normal.

At the operation the appendix was found adherent to the mesappendix at its tip. It was quite red and inflamed-appearing. No enlargement of the mesenteric glands was noted.

The convalescence was rapid and at the present writing the patient is quite well.

Pathological.—The appendix measures 6 cm. in length, 7.5 mm. in diameter at base, and 1.5 cm. in diameter at its tip. The cecal end looks almost normal, while the outer two-thirds of the appendix appears inflamed and adhesions are present upon this part of its surface. On cross sectioning, an apparently normal lumen is seen at the cecal end, a wider one in the middle third, and no lumen in the outer third. The outer 1.5 cm. of the appendix shows in place of a lumen a yellowish core which contrasts with the paler surrounding ring of appendix.

Sections were taken at various levels. That through the cecal end on microscopical examination shows a practically normal appendix. Section from the middle third presents a mucosa intact and fairly normal-appearing. The submucous, muscular, and peritoneal coats show acute inflammation as evidenced by a marked infiltration with polymorphonuclear leucocytes, plasma cells, and exudate.

Sections of the tip show that the yellow core observed macroscopically is a carcinoma which has filled the lumen, has entirely replaced the mucosa and submucosa, has invaded the circular muscle coat, and at one point at least has reached the longitudinal muscle coat. The muscular and peritoneal coats show products of acute inflammation similar to those observed in the middle third of the appendix. The carcinoma cells are arranged in little groups between which run bands of fibrous tissue. The majority of these groups are solid, as is seen in the cell nests of an epithelioma, but here and there a gland type is seen and one can follow the changes from the solid nest to an almost normal crypt of Lieberkühn. The individual cells are polygonal in shape, larger than normal gland cells. The nuclei show considerable irregularity in staining and in size. This tumor can properly be considered as a primary adeno-carcinoma of the appendix.

Several specimens similar to this and also some other forms, as the colloid, of primary carcinoma of the appendix, have been reported. Dr. E. Hurdon reported a case from this laboratory. Kelly, of Philadelphia, in 1900, reported two cases and collected from the literature eleven others. A. W. Elting quite recently reporting three cases of his own, analyzed the entire literature, and after excluding a number of cases where insufficient pathological proof is given, found in addition to his own twenty other authentic cases. As this specimen and the clinical observations clearly suggest, it is probable that the number of such specimens will multiply rapidly with the spread of the practice of careful laboratory study of specimens obtained, not only by operation, but also by autopsy. For it seems credible that most carcinomata in the appendix would sooner or later lead to inflammatory conditions; in case the surgeon intervened soon enough to conditions similar to that in our specimen; if left alone, to those of abscess formation or of general peritonitis. The small primary neoplasm is completely obscured by the large secondary inflammatory process, unless recourse be had to microscopic examination.

The inflammatory process present in this case is an acute one and in the specimen there remains little to suggest previous inflammatory changes. The neoplasm, from its extent and its activity as manifested by cellular changes, would seem to be less than two years old. The history points to attacks over a period of two years. The specimen affords no absolute data by which can be decided as to whether the original attacks antedated the appearance of the neoplasm or not.

From the appearance of the tumor, however, I am inclined to believe that the carcinoma developed in an appendix previously the site of inflammatory changes. To the advocate of early operation in appendicitis, either of these possibilities, i. e., the occurrence of carcinomata in inflammatory appendices or of inflammation of the appendix resulting from cancers, is welcome as no small support to his contention.

Case III.—Primary Tuberculosis of the Appendix. (Gyn.-Path. No. 6825. Miss ——, æt. 28. Private patient of Dr. Cullen.

Family History and *Past History* unimportant. No history of any tuberculosis.

Present Illness.—For about a year the patient had had a dull pain in the right lower quadrant of the abdomen. There had been no acute attacks of pain. No diarrhea or blood had been noted in the stools.

Physical Examination.—At the time of the operation there was no sign of tuberculosis in the lungs or elsewhere on physical examination. Her temperature was normal. At operation the appendix was found very red and had a peculiar "pock-marked" appearance. It was not adherent. The uterus was in retroposition. Otherwise the abdominal viscera seemed normal.

The appendix was removed and the uterus suspended.

The patient made a rapid, uneventful recovery from the operation and is relieved of her symptoms.

Pathological.—The appendix measures 5 cm. in length and 1 cm. in cross diameter. The caliber is pretty constant from end to end. On cross section at different levels the lumen is seen to be present save in the tip 1 cm. The mucosa is thickened, about 2 mm. apparently. Sections were made at different levels.

Microscopical.—The mucosa in some places is intact. In others is entirely replaced by caseous material. The submucosa is infiltrated with tubercular tissue, poorly staining epithelioid cells, areas of caseation, and in some places typical tubercles with a giant cell in the center, surrounded by epithelioid cells can be seen. The circular muscle coat is in places invaded by the tubercular process, but it extends no further, the longitudinal muscle coat and the peritoneum showing no alteration. Tubercle bacilli were readily demonstrable in the sections.

Case IV.—Tuberculosis of the Appendix. (Gyn.-Path. No. 6769.) Mrs. H. ——, æt. 37. Service of Dr. Kelly.

Family History is entirely negative to tuberculosis.

Past History.—For past thirteen years patient has been delicate, being subject to gastralgic attacks. She has had three children. She has had no trouble with menstruation.

Present Illness.—Its onset was in the fall of 1902 with pain in the right lower quadrant of the abdomen. This pain had been continuously present from that time until her admission, June 6, 1903, to the hospital. It varied in intensity and was greatly aggravated during the menstrual periods. There was some history of a chronic cough during the past months. There had been no blood in the stools nor diarrhea.

Physical Examination.—Some enlargement of the glands of the neck; indefinite signs of trouble at the apices; tenderness and muscle spasm in lower abdomen, especially on the right side; a temperature of 100°; a leucocyte count of 12,000; an unsatisfactory pelvic examination, were the important observations on her admission to the ward.

Under ether, the uterus, tubes and ovaries felt normal on palpation, and a diagnosis of probable appendical abscess was made, as a mass could be felt in the region of the appendix.

Treatment and Course.—An incision was made directly over the tumor, which was found to be composed of an adherent mass of omentum, appendix and cecum. No pus was present.

The appendix was retrocecal, the lumen in its outer third was obliterated, in its middle third normal, at the cecal end very narrow. A fistulous opening existed between the middle third of the appendix and the cecum.

The appendix was removed and the openings in the cecum were closed. No tuberculosis was present, macroscopically, on the tubes, ovaries, or elsewhere in the immediate region. The entire peritoneum was not examined, but so far as seen it looked normal.

The incision was drained.

Convalescence was slow; the sinus caused by draining had not entirely closed at the time of her discharge from the hospital. She had an intermittent fever, unaccompanied by a leucocytosis. She had some cough, but no tubercle bacilli were demonstrated in the sputum.

Pathological.—The appendix measured 7 cm. in length and .5 cm. in diameter. Dense adhesions were present on its surface. The condition of the lumen is described above. The mucosa appeared normal.

On microscopical examination the mucosa in a section from the middle third was mostly normal-appearing. In the submucosa on one side was a group of typical tubercles with giant cells in the center surrounded by epithelioid cells. The tuberculosis was mostly limited to the submucosa, but at one point extended almost out to the peritoneum.

Remarks.—Of Cases III and IV it can be said: that Case IV is not a tuberculosis limited to the appendix and probably is not a primary tuberculosis of that organ; that Case III is a primary tuberculosis of the appendix so far as a clinical diagnosis of such a condition is possible. The only absolute way to determine it would be by autopsy. Some light might have been gained by the use of tuberculin after operation, but the patient was never in the hospital and the opportunity to do this was not present.

As has been repeatedly suggested by those who have reported clinical cases resembling Case III, there is no reason why a primary tuberculosis of the appendix should not occur. So far as I know there is no case reported which meets the autopsy standard of proof. It would seem at autopsy that even cecal tuberculosis, which is the commonest variety of intestinal tuberculosis, is rare as a primary or at least as a

solitary tubercular condition. Eisenhardt, who is extensively quoted, in 1000 autopsies on tubercular patients, found intestinal tuberculosis 563 times, but in every case there was lung involvement. In no case did he find the appendix alone involved of the intestinal tract. It is by no means to be considered, however, that the failure to find confirmation in autopsies is conclusive against the condition, for it is self-evident that patients who die of tuberculosis will almost certainly have extensive lesions, and therefore it will no longer be possible to locate the primary seat of the disease. On the other hand, the surgeon is not prepared to settle the question. We know well how after the removal of a large tubercular focus, as, for example, the fallopian tubes and uterus, the patient will improve greatly in health and apparently entirely recover, even when there is positive evidence that other parts of the body not removed are tubercular.

It is evident that neither of the patients had extensive intestinal tuberculosis. It seems quite likely that in Case IV the disease in the intestine was limited to the cecum and appendix. The cecum was found somewhat thickened at the operation. Had a diagnosis been certainly made the question of excision of the cecum would have arisen.

Both of these appendices belong to the typical tubercle ulcerative type, in contradistinction to the hyperplastic type as occurs in Crowder's case.

The number of cases of primary tuberculosis, even from the clinical standard, published, is small. A much greater number of appendico-cecal cases have been reported. Among the appendical cases are those of Carl Beck, 2 cases; Karewski, 2 cases; Sonnenburg, 2 cases; Crowder, a case; Potel, a case; Mosher, a case; Josselind Jung, a case.

These cases present the clinical aspects of ordinary inflammations of the appendix, mostly, as in our case, that of a chronic condition. The diagnosis in life would always be doubtful. The indication for a radical operation is greater than that of an ordinary appendicitis. The presence of these cases, as likewise those of primary cancer and primary actinomycosis, make an additional danger in appendicitis to that usually considered and add support to the justification of early operation in all cases.

From theoretical grounds and from comparative results of removal of tubercular foci elsewhere, the results should be good. As a matter of fact they are good, as we find by reading the publication of the results of operative treatment of cecal tuberculosis. It does not fall within the limits of this article to give these results, but I refer those desiring to know them to the excellent consideration of the subject by Professor Mikulicz in the Handbuch der Pract. Chir. of Mikulicz, von Bergman, etc.

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NOTES ON NEW BOOKS.

American Year-Book of Medicine and Surgery for 1904. Being a Yearly Digest of Scientific Progress and Authoritative Opinion in all branches of Medicine and Surgery, etc. Under the general editional charge of George M. Gould, M. D. Surgery. (*Philadelphia, New York and London: W. B. Saunders and Co., 1904.*)

The temptation, in noticing a book of this sort, is to dismiss it with some facile cynicism about "tabloid literature" and to extend our censure of pre-digested mental food until it includes Dr. Gould and his Year-Book. The merest glance through its pages, however, suffices to show that such an easy commonplace is not in this case pertinent. The book meets an actual demand, and the demand is not for superficial notices, which are primarily readable, but for accurate reviews which are primarily thorough. A good résumé is never easily made, but in this volume this work is always well done; and the book, considering its almost encyclopedic scope, together with its physical limitations, is little short of excellent. It is comprehensive and it is terse; furthermore, it does not bulk unnecessarily, and the material is conveniently arranged. We cannot think of any principle of selection in choosing the articles for review which would meet all demands, but the Year-Book of Surgery for 1904 has certainly given due—some will think, undue—prominence to the American literature; and we doubt if American journals have contained as large a proportion of the medical articles of value as the references in Dr. Gould's book might suggest. Certainly some of the minor characters have a good many lines to speak in this volume, which is somewhat aggravating for busy men who have come to see the star performers.

The Medical Annual. A Year-Book of Treatment and Practitioner's Index. (*Bristol: John Wright & Co.*, 1904).

The Medical Annual for 1904 keeps up the high reputation of the work. The list of contributors is excellent; two are especially well-known here, Mayo Robson, who writes on abdominal surgery, and Dr. Saundby, who discusses renal and urinary diseases. The volume opens with an excellent review of the work in Therapeutics for the past year. The extracts throughout are good, and it is pleasant to see that American literature receives full attention. The illustrations are a special feature of this volume, one set of plates showing the surgical anatomy of the ear and others the skin lesions of acute infections. Everywhere special attention is given to treatment. The work can be highly recommended and should be found very useful by the general practitioner.

The Practical Medicine Series of Year-Books. Vol. II. General Surgery. Edited by JOHN B. MURPHY, M. D. (*Chicago: The Year-Book Publishers, November, 1903.*)

This small volume is composed of abstracts of articles which have appeared in the various foreign and domestic journals during the preceding year, and purports to give in this way a fair idea of surgical progress during that period.

The general appearance of the book is unattractive, and the paper and print are poor. These are, however, a very fitting index to the character of the text. There are numerous typographical errors. The abstracts, while fairly well selected, are poorly executed, in fact in many instances the sentences are meaningless jumbles of words. On page 41 we find the following: "Is the average surgical patient actually less in danger from infection if the surgeon wears rubber gloves? First, as to the surgery. Theoretically, the hands need to be resterilized during the operation. Blood serum is, however, a very potent germicide, and this fact is overlooked by most of us." On page 118 this sentence occurs: "Transplantation of tumor cells through so many generations would seem to prove that the life of ordinary tissue cells may, under conditions not realized in one organism, be able to live much longer than the individual to which they belong"; and again, on page 470, the following: "Another condition which leads to quite profuse hemorrhages can be readily recognized cystoscopically, and, besides, profuse hemorrhages are always encountered."

The remarks interpolated by the editor are always concise, lucid and interesting. The book can be hardly recommended to students as an example of correct English construction.

Social Diseases and Marriage. Social Prophylaxis. By PRINCE A. MORROW, A. M., M. D., Emeritus Professor of Genito-Urinary Diseases in the University and Bellevue Hospital Medical College New York, etc. (*New York and Philadelphia: Lea Brothers & Co., 1904.*)

This volume of nearly 400 pages ought to be read and carefully considered by every physician. It is a model of clear statement and frank advice. Its object is to point out the obstacles which venereal diseases ought to be to marriage and the danger to the health of a wife or an unborn child from them. If all conscientious physicians who are called upon to treat these disorders could be induced by reading the book to give to persons infected with gonorrhœa or syphilis who contemplate marriage the wise advice which reason and knowledge dictate, the number of innocent victims of venereal infection would be materially lessened. The author is not an extremist and writes with moderation, and hence his words should be heeded.

The third section of the book on social prophylaxis will commend itself to all thinking people, laymen as well as physicians. The author evidently favors a legislative enactment to penalize the transmission of venereal disease to innocent persons, although he does not advocate it unreservedly. The true remedy after all is to educate the young man as to the dangers which he will encounter in an unchaste life, and the young woman that it is never safe to marry a licentious man.

Modern Surgery, General and Operative. By JOHN CHALMERS DA COSTA, M. D. Fourth edition, rewritten and enlarged, with 707 illustrations, some of them in colors. 1099 pages. (*Philadelphia, New York, London: W. B. Saunders & Company, 1903.*)

"The work stands between the complete but cumbrous textbook and the incomplete but concentrated compend. . . The effort has been to present the subject in a form useful alike to the student and busy practitioner."

Such, in brief, is the introduction the author gives to his work. It is an efficient one, protecting him on the one hand from the charge of incompleteness and on the other from that of unnecessary detail. Usefulness of course is the highest attribute to which such a production can lay claim. The large number of text-books of surgery which have just such a scope as the one under consideration is evidence that it is easier to write a useful book than one which can claim for itself accuracy, thoroughness and finish. It seems that by this time we must have enough useful books to supply the demand of students and practitioners, and let us hope that from now on the publications of men of large experience and keen insight may cover a less extended field with more completeness and greater authoritativeness. It is almost necessary, of course, that when one man writes a "surgery" he should take bodily much of the work of other men, and this not always from the original publications, so that by this time the text-books have found, as it were, a dead level, varying little in their treatment and statements, and presenting the hall-marks of much borrowing. Unfortunately in this way

the individuality of the author tends to be swallowed up in the necessity he is under of accepting so much of other people's work and indorsing it.

There can be no doubt that Dr. Da Costa has presented a very useful work, and one that has a definite and indicated mission to the large class to whom he addresses it. Like other books it has an operative department. It is hard to conceive what the value of such a section can be. It is impossible that one could learn to operate or could be guided to any extent by the descriptions given of the operative procedures. They are entirely inadequate to be of aid in the actual technique of surgical work. They may possibly aid to a small extent in elucidating the general principles that should guide the operator. It seems, however, that the day must be almost past when the general practitioner would read the description in his text-book before sallying out to do a laparotomy. One expects the surgery of the present day to be done by trained surgeons. There is always room of course for careful descriptions of operations and improvements in methods.

It speaks well of the author that he and his experience and judgment are not lost sight of through the work. As a matter of fact there are few sections where his surgical personality does not show through and redeem the book from mediocrity. For the most part his descriptions and advice as to treatment are complete, and at the same time succinct. There is an unusual faculty in the book of saying much in a small space. Generally subjects are thoroughly covered for all practical purposes and set forth clearly, tersely and with rare good sense and judgment. The writer's individual suggestions seem to us to be the most valuable part of the work. Where he stops to comment on his own experience and surgical habits or to point out among a number of procedures the ones which, in his opinion, are most fitted for given occasions, one is struck with his broad knowledge, thorough principles and excellent discrimination. There are many places where methods of diagnosis and treatment are impartially set forth with a view more to completeness than to urging any particular one, where we would gladly have the author's personal advice. In other words, more of Da Costa and less of time-honored surgery seems to be indicated, or at least desirable.

The book is more up-to-date in its references than most of the other books. There is due appreciation of the work (the American work especially) done during the last two or three years. The writer seems to have taken time to examine the work of other men, and this alone makes his own observations of more value than those of a more self-centered surgeon.

The first section in the book is devoted to bacteriology, and an accurate, practical, concise account is given, with good remarks on antiseptics. The comments on iodoform, its uses and limitations, seem to us to be particularly good. It is recommended for use in abscesses and tuberculous foci, where it is claimed that it stimulates granulation and connective tissue formation, though it is not strictly a germicide. Da Costa says no clinical substitute has yet been found for it. There is a very clear and satisfactory presentation of the important theories of bacteriology, serum therapy, etc. As to the description of the bacteria themselves, the accounts are rather unsuited to surgical application. Not enough stress is laid on the fact that in addition to the ordinary pyogenic cocci many bacilli and cocci, not ordinarily thought of as pyogenic, invade tissues as pus formers.

The chapter on asepsis and antisepsis is very good. It is practical and complete enough and up to date. The remarks on the use of gloves, which he commends, are timely and the advice as to the choice of suture materials presents the almost united views of the best surgeons. Catgut, silk and silver are recommended as the most useful and reliable. In the description of dressings the mistake is made of classing silver foil among the non-absorbable dressings, whereas in reality it is a perfectly absorbable dressing allowing blood and serum to go through into the overlying gauze and almost invariably leaving a dry wound. Surgeons have been curiously slow in appreciating this dressing. There can be little doubt that it is an ideal dressing for most new wounds.

The description of the phenomenon of inflammation and its treatment and of the process of repair of wounds, etc., is modern and practical. There is a very good account of the pathology of the conditions. Little account, however, is taken of the various organisms that give rise to infections, and the differences in the severity of symptoms and the indications of surgical treatment which depends on the organism concerned.

Tuberculosis is discussed quite exhaustively from a surgical standpoint, yet in a concise form. The remarks on the use of tuberculin in diagnosis are rather remarkable in the light of the general modern spirit of most of the book. Speaking of the tuberculin test for purposes of diagnosis purely, he says: "The value of the test is not certain; its results are irregular, a negative result certainly does not rule out positively the existence of tuberculosis; it is not certain that the procedure is absolutely innocuous, and it is certain that the method is entirely useless and possibly dangerous unless employed by a trained and skilful man." This opinion will not hold good, we feel sure, in the face of the rapidly increasing use of tuberculin and the accumulated evidence of its sureness and great value in diagnosis when used judiciously. Its administration is governed by a few simple rules and is practically devoid of bad effects, with a good grade of tuberculin.

One of the best accounts is that of sarcoma and carcinoma. The author seems to appreciate, as not all surgeons of large practice do, the necessity of medical treatment in these conditions. In remarking on the operative treatment of cancer of the breast, however, he simply quotes Halsted's description of his operation and makes no comments on it, but leaves the idea that his own advice would be toward a less complete operation. This is also a little surprising, considering the experience of most clinics.

A subject that has interested surgeons very recently is that of osteomyelitis. Though Da Costa devotes a good deal of space to this disease and presents many useful facts concerning it, still he fails to give a clear account of the pathological development and sequence of the infection; and the remarks on sequestrum formation will probably have to be revised when compared with the recent careful work of Nichols on the subject. The incidence of septicæmia in acute osteomyelitis and its possible causation of the diagnosis of typhoid fever, so frequently made, is not mentioned.

Orthopedic surgery is rather summarily treated with the time-honored remarks and plates that are seen in all text-books.

One of the best sections is that on the surgery of the brain. It is full and clear and the descriptions of the operative methods are excellent, as are the figures describing the topography and surgical points on the skull. Much deserved credit is given to Keen. He recommends trepanation for palliative purposes in the treatment of all forms of brain tumor, whether it is thought possible to remove the tumor or not. Headache, vomiting and the advance of optic neuritis are often checked and the patient's last days passed in comparative comfort. He does not speak of the necessity of very careful closure of the scalp and absolute control of hemorrhage in the wound's deeper parts, to avoid the subsequent possibility of brain fungus—a point much emphasized by Cushing.

Much space is devoted to abdominal surgery. As usual, bone plates, Murphy buttons, various forms of anastomoses, stitches, etc., are greatly in evidence. The various surgical conditions of the peritoneum and organs are well described and little is lacking to satisfy the student or practitioner. On the whole, one

would say that the chapters on abdominal surgery are characterized by a conservatism unusual with American surgeons. In fact, many of the procedures have largely been discarded in the past few years for different and usually more direct methods. It is surprising that the author scarcely mentions excision of the gall-bladder in dealing with cholecystitis, gall-stones, etc. Some surgeons would accuse him of being ten years behind the times in his gall-bladder surgery. He is against immediate operation in acute appendicitis, as the rule. In this he would have the support of many eminent surgeons. Space will not allow a more extended discussion of this most important section. It may be said that its excellencies are many. The student will find it an excellent reference-book of unusual completeness and carefulness.

There is one other detail of the work we should like to notice. In dealing with the treatment of hemorrhoids he shows that the Whitehead operation is in great disfavor with him. He says: "Only a surgeon who can master violent hemorrhage should venture to perform it. Primary union is rarely secured. . . . Experience shows that stricture not infrequently arises after its performance, that fecal incontinence occasionally results and that anal anæsthesia with inability to restrain the passage of wind is common." It is quite evident that Dr. Da Costa is not familiar with the Whitehead operation. While it is not the simplest of operations, yet for one who aspires to be a surgeon, it offers no terrors from violent hemorrhage or suppuration or following stricture. Like most other operations it can be done in a right and in a wrong way. With moderate care and the application of ordinary surgical knowledge the hemorrhage is never serious, healing *per primam* is the rule, and stricture the rarest of complications, probably less frequent in this than in the clamp and cautery operation. Fecal incontinence generally lasts two or three days only, and is so rarely a permanent complication that it is hardly considered. An operator so unskilful as to cut the sphincter ani would do poor work in any procedure. The results of the Whitehead operation are most satisfactory when a long series has been studied. The cure is permanent.

Dr. Da Costa's book is worthy of a more extended consideration which space forbids, however. On the whole it will be found a very satisfactory work for the readers to whom it is addressed. The evidence of thoroughly good surgical principles is its best recommendation.

Clinical Talks on Minor Surgery. By JAMES G. MUMFORD, M. D. Small 8vo, p. 115. (*Boston: The Old Corner Bookstore, 1903.*)

This small volume the author modestly states in his prefatory note, deals with "homely, commonplace subjects," that "find little place in the text-book and lend themselves but feebly to brilliancy of demonstration." The ten informal clinical lectures, or "talks," that form the basis of the book deal in a general, common-sense way with subjects such as *incised wounds, granulating wounds and varicose ulcers, felon, whitlow, paronychia, palmar abscess, boils, ingrowing nails*, etc. Though "homely" subjects they are treated in a far from "commonplace" fashion and enlivened, as the chapters are, by frequent historical allusions, by epigrammatic sentences which cling in the memory, all in Dr. Mumford's attractive style, the reader finds that he is able to write "perlegi" at the end of the volume with some disappointment that it is not longer. A third-year student, beginning his acquaintance with minor surgery, will read this little book with the greatest profit; a graduate, with equal interest, and many of them will regret that those simple, everyday subjects were not presented to him in similar graphic fashion in his undergraduate period.

In illustration of the crisp style in which the lectures are delivered one may quote the last lines of one of the chapters: "Don't coquet with a carbuncle. Cut it out as you would a cancer, and you will never regret it." At the time of the demonstration the author suited his words with the action. The scene is readily visualized by the reader. H. C.

The Treatment of Fractures. By CHAS. L. SCUDDER, M. D., Surgeon to the Massachusetts General Hospital. Fourth edition, thoroughly revised, with 688 illustrations. (*Philadelphia, New York, London: W. B. Saunders & Co., 1903.*)

Four editions of this work since it was first published testify to its value. The book is essentially practical, and is intended to serve as a text-book for the student as well as a guide to the practitioner. The various fractures are described in detail and yet concisely, so that the reader gets a good mental picture of the cases. Then, too, each lesion is illustrated not only by photographs of the injured part and of prepared museum specimens, but also by skiagraphs and X-ray tracings. This gives a fourfold aspect of the broken member which greatly assists in the proper treatment.

The chapter on gunshot fractures is especially valuable in that it gives the results of observations made during the Boer war upon the modern high velocity projectiles.

The Rœntgen ray and its relation to surgery, by Dr. Codman, forms another interesting chapter. After discussing its value, Dr. Codman points out the need of skilled interpretation of the negative.

The value of the book is greatly enhanced by the number of extremely good illustrations it contains. The skiagraphs and X-ray tracings are particularly interesting, illustrating, as they do, the various fractures. The book is well worth reading.

The Worth of Words. By DR. RALCY HUSTED BELL. With an Introduction by DR. WILLIAM COLBY COOPER. Third edition, revised and enlarged. (*New York: Hinds & Noble, Publishers.*)

This book is mainly interesting to the physician from the fact that it has been written by a physician and the introduction has been supplied by a brother physician. In the introduction we are informed that "Dr. Bell is a poet—not a mute inglorious Milton, but a songful poet." As, however, no samples are given of the work of this "songful poet" we are compelled to receive the statement for what it may be worth. His little book on the worth of words is interesting and often suggestive, although sometimes marred by slang words and sentimental exuberance.

The Man who Pleases and the Woman who Charms. By JOHN A. CONE. "Look out lovingly upon the world and the world will look lovingly in upon you." (*New York: Hinds and Noble, Publishers.*)

This prettily printed little book of more than 100 pages is full of agreeable commonplaces to enforce the precept that courtesy should be studied as an art. The quotations are appropriate and aid to emphasize the doctrine. A good example is the following: "It is not what you wear in this life, gentlemen, it is how you wear it. It is not so much what you do; it is how you do it."

Howe's Handbook of Parlimentary Usage, Arranged for the Instant Use of Legislative and Mass Meetings, Clubs and Fraternal Orders, Teachers, Students, Workingmen, etc. By FRANK WILLIAM HOWE. (*New York: Hinds & Noble, Publishers, 1904.*)

This is a most handy little manual, and one which cannot help being profitable to a timid or inexperienced chairman. Physicians, as a rule, are indifferent presiding officers and prob-

ably stand in need of a manual of this character more than any other persons.

The Complete Medical Pocket Formulary and Physician's Vade Mecum: Containing upwards of 2500 prescriptions, collected from the practice of physicians and surgeons of experience, American and Foreign, arranged for ready reference under an alphabetical List of Diseases. Also a special list of New Drugs, with their Dosage, Solubilities and Therapeutical Applications. Together with formulæ, tables, etc., collated for the use of practitioners. By J. C. WILSON, A. M., M. D., Physician to the German Hospital, Philadelphia. Third revised edition. (*Philadelphia: J. B. Lippincott Company.*)

This is a useful and complete book which ought to be consulted by the physician as well as by the medical student. The formulæ contained in it should not be blindly followed, but rather should be considered suggestive of lines of therapeutics to be employed in given diseases. The book has a recognized place in the library and a definite range of utility.

Les Nerfs du Cœur chez les Tabetiques. A clinical and pathological study. By DR. JEAN HEITZ, Ancient Interne des Hôpitaux de Paris. (*Paris: G. Steinheil, Editeur, 1903.*)

The first part of this work is taken up with a detailed résumé of what is actually known of the cardiac plexus, the anatomy and histology of the pneumogastrics and sympathetics and of the plexus itself. As for the physiology, the author has gone especially into the question of cardiac sensibility and the trophic influence of the plexus on the aorta and the myocardium.

The second part gives a complete review of all that has been written on the cardiac symptoms in tabetics. This is followed by the results of a very careful histological examination of the pneumogastrics in four cases, of the sympathetics in six cases, and of the cardiac plexus in twelve cases of tabes. The author shows that in the majority of cases there is a definite lesion in the fibers making up the plexus. Also that there is no causal relationship between these lesions and the aortitis; and that this is not a trophic trouble but should be considered to be of a syphilitic nature.

The singular latency of this form of aortitis in so many cases he thinks to be due to the lesions in the sensory fibers of the cardiac plexus.

Dispensing Made Easy. With Numerous Formulæ and Practical Hints to secure Simplicity, Rapidity and Economy. By WM. G. SUTHERLAND, M. B. (Aberd.), formerly House Surgeon Queen's Jubilee Hospital, London, etc. (*Bristol: John Wright & Co.; London: Simpkin, Marshall, Hamilton, Kent & Co., Ltd., 1904.*)

This is a plain, practical book, written more for English than American conditions. The directions given are clear and concise. The work will be eminently helpful to all physicians who dispense any portion of their own prescriptions.

The Physiognomy of Mental Diseases and Degeneracy. By JAMES SHAW, M. D., Member of the Medico-Psychological Association, etc. (*Bristol: John Wright & Co.; London: Simpkin, Marshall, Hamilton, Kent & Co., Ltd., 1903.*)

Illustrations of the various forms of mental alienation and degeneracy have a distinct value and a recognized place in medical teaching. The representations of morbid conditions presented in this book are carefully selected and admirably described in the letter-press. The book can be recommended to all students of medicine.

Traité de Radiologie Médicale. Publié sous la Direction de CH. BOUCHARD, Membre de l'Institut, Professeur de Pathologie Générale à la Faculté de Médicine. (*Paris: G. Steinheil, Publisher, 1904.*)

This two-volume edition has been written on the plan so frequently seen of late in our various text-books of medicine, each chapter and division being the product of a different author.

Vol. I deals entirely with the technical side of the X-ray and high-frequency currents, each part of an equipment being taken up and discussed at length. In fact, so much detail is given that at times it becomes wearisome. For example, the first 175 pages are devoted entirely to a discussion of electrical currents and their methods of production. In all, about 450 pages are given up to descriptions of the various electrical appliances.

Vol. II consists of about 600 pages, and of this nearly 200 more deal with the method of running the apparatus. The remaining 400 pages deal with the value of the X-ray in diagnosis and therapeutics. In this section probably the most interesting chapter is that devoted to the discussion of "The Diseases of the Chest." The method of examination is described and one is given graphically and concisely the salient features of the various affections.

In the chapter on calculi, the point is well taken that a negative diagnosis does not absolutely exclude the presence of a stone; under certain conditions a soft stone may be present and yet not cast a shadow.

In the treatment of carcinomata and various skin lesions the old question is discussed as to whether burns are due to electrical disturbances or the X-ray. This question has been settled so long that one is surprised that the author should think it necessary to give such a detailed explanation defending his belief that the X-ray alone causes burns.

In conclusion, we may say that the book as a whole is distinctly disappointing. The subject-matter contains nothing new and is simply a reiteration of existing facts, not even especially well presented. The illustrations are few and for the most part not particularly good.

The book belongs more properly to the physical rather than to the medical side of the X-ray.

Infectious Diseases: Their Etiology, Diagnosis and Treatment. By G. H. ROGER. Translated by M. S. GABRIEL. (*Philadelphia: Lea Bros. & Co., 1903.*)

The author considers first the general character of infectious diseases and of the pathogenic bacteria associated with them, defining an infectious disease as characterized by the phenomena manifested in individuals when undergoing the action of parasitic toxins and reacting against them. Methods of invasion of the organism and the general mechanism of the action of bacteria upon the individual are next discussed, after which the more special subject of the influence of the association of several organisms is taken up. Various special effects of such invasions, suppuration, gangrene, etc., are treated in separate chapters, which are followed by others which describe in more detail the changes produced in the various organs. The mode of onset and development and after-effects of the disease lead to the consideration of the development of immunity and of the efforts which may be made in prevention and cure of such diseases.

Such is in general the outline of a book which is original in that it brings together far more closely than usual the recent acquisitions of knowledge made in the laboratory with the observations of the clinic. Evidently M. Roger is an extraordinarily diligent and acute observer in the laboratory as well as in the clinic, for the amount of material is very great—so great, indeed, that in a short review it would be impossible to speak of special points.

In general it seems that the author's attitude toward the litera-

ture, and especially the French literature, is not a very critical one. Results are frequently accepted and stated as facts when confirmatory evidence would add greatly to one's feeling of security. To quote Ribbert, "Man lässt sich dadurch leicht im eine die weitere Forschung hemmende Sicherheit wiegen." Especially irritating are the attempts at the classification of various forms of disease or modes of infection, in which, with the demand for a well-rounded, plausible system so characteristic of the French, elaborate and unnecessary subdivisions and artificial analogies are printed in tables which finally remind one of the lists of phrases in Rabelais.

Nevertheless, the book presents a very interesting survey of the work done in connection with infectious diseases up to a recent period. Doubtless in another edition the chapters on immunity and on special infections will be enlarged to represent the still more modern views. It is particularly interesting in that so much of what is written is based on the work of M. Roger himself and of his pupils.

Diseases of the Skin: An Outline of the principles and practice of dermatology. By MALCOLM MORRIS. (*Chicago: W. T. Keener & Co., 1903.*)

This new edition of Morris' excellent outline of dermatology shows a decided improvement over the old edition of Lea Bros.; the binding is flexible, of a pleasing green color, and seems durable; the paper is of a better quality, the printing clearer, and the symptomatology, etiology, etc., of diseases are separated by black type, which is a very helpful change.

To keep the scope of the book within the limit of an "outline," and allow for much new material, a careful revision of every article was made necessary. This has been accomplished and the volume of the book increased by only fifty pages.

Twelve entirely new articles are added, among which may be mentioned Blastomycetic dermatitis, Von Recklinghausen's disease, Parakeratosis, and Parakeratosis variegata.

It is fortunate that the author saw fit to omit the colored plates of the last edition. Very few had any resemblance to the diseases they represented, and all were disfiguring. A much better idea of the appearance of skin eruptions is conveyed by the numerous photographs and photomicrographs with which it abounds.

A Text-book upon the Pathogenic Bacteria, for Students of Medicine and Physicians. By JOSEPH MCFARLAND, M. D. (*Philadelphia, New York and London: W. B. Saunders & Co., 1903.*)

Recent progress in bacteriology has made new editions of all our standard text-books on this subject necessary, and Dr. McFarland has just presented us with a third edition of his work. In it he has taken account of the new ideas of both German and French scientists as well as of those of American investigators. The book is especially valuable for its very explicit treatment of the subject of toxins from both the theoretical and practical aspects. In the chapters devoted to the consideration of the chemical constitution and mode of action of the toxins and the antitoxins, he has given considerable space to the exposition of Ehrlich's famous "side chain" theory, not forgetting at the same time Metchnikoff's no less important theory of "phagocytosis." From the practical standpoint as well, the application of these theories to the preparation of the two most important antitoxins—diphtheria and tetanus—has been especially emphasized.

Along with these chapters dealing with toxins and antitoxins, the nature and the action of the whole series of anti-bodies, anti-rennin, anti-venin, anti-hæmolysin have been carefully considered. Separate chapters are especially devoted to the consideration of each infectious disease, the nature of the etiological factors and the value of remedial agents being carefully discussed. The portions of the text-book dealing with the principles of bacteriology have been considerably enlarged and improved upon, in comparison with the second edition, especially with regard to the very important subject of species differentiation, and several important and valuable charts have been incorporated in the new material.

A new chapter, giving the investigations of Shiga, Flexner and many others, has been devoted to dysentery, and the chapter on yellow fever has been modified so as to accord with the investigations of Reed and Carroll.

Despite a few minor errors, and despite the author's failure to exercise a sufficiently rigid critical judgment, the book is full of valuable information, especially for the medical student, and next to Crookshank's Manual is the best book in English on animal diseases—considered from the standpoint of etiology and treatment, with the possible exception of Moore's recent book on a similar subject.

A Text-Book of Practical Gynecology, for Practitioners and Students. By D. TOD GILLIAM, M. D., Professor of Gynecology in Starling Medical College, Columbus, Ohio. (*Philadelphia: F. A. Davis Co., 1903.*)

Conforming with the prevalent practice of writers of text-books on the diseases of women, the author treats of the bladder, kidneys and rectum in addition to those subjects to which the name gynecology can more accurately be applied.

The book is well printed, on good paper, and contains more than 350 illustrations. The arrangement of the matter is systematic. The first chapters are given to a consideration of general etiology, technique at operation, method of examination, etc. The organs are then taken up in anatomical order and considered as to their various pathological conditions. Throughout the treatment is brief, but the frequently associated adjective *lucid* cannot be here applied. Subjects are served up in a very fragmentary way. The book abounds in detached dogmatism, unsupported by reason or authority. Scant reference is made to the literature. In a word, the book is a poor one, and in the opinion of the reviewer contains little to justify its existence, as so many better ones are already available.

Golden Rules for Diseases of Infants and Children. By GEORGE CARPENTER, M. D. (Lond.), M. R. C. P. Golden Rule Series, No. XI. Second edition, enlarged. (*Bristol: John Wright & Co.; London: Simpkin, Marshall, Hamilton, Kent & Co., Lim.*)

This admirable little book of 167 pages contains a large amount of useful information respecting the disorders of infants and children. This information, it is gratifying to notice, is modern and helpful. Thus, for example, injections of antitoxin are prescribed for diphtheria, an examination of the blood for malarial disease, and an examination of the blood in typhoid fever for the Widal reaction. We regret to see the word enteric fever used instead of typhoid, as tending to mislead the student. A good index serves to render the contents of the volume more accessible to the reader.

A Non-Surgical Treatise on Diseases of the Prostate Gland and Adnexa. By GEORGE WHITFIELD OVERALL, A. B., M. D. (*Chicago: Marsh & Grant Company, 1903.*)

This monograph is another example of the alliance, frequently if not always unfortunate, between medicine and applied physics; for when one sees the pages of a book studded with such words as "cataphoresis," "electric osmosis" and "sinusoidal," the mind naturally reverts to Perkinism and the previous as well as the subsequent systems of mechano-therapeutics which have careered, like comets, into medical history and, like comets, have careered out again into the night. Not that the devotion of Professor Overall (A. B., M. D.) to physical therapeutics has biased his mind away from drugs. The pharmacopeia he knows with

something of a lover's intimacy. Oil of gurgin, extract of triticum—all the rarer herbs and simples which the ordinary practitioner will do well to have heard of—Dr. Overall knows not only by name but by dosage; and it would seem that the catholicon, for which prostatic surgeons have waited so long, would sooner have been available if the power of drugs when joined, in the mystic bond of "cataphoresis," to the powers of electricity, had not been overlooked. Dr. Overall is an exponent of "no-knife" medicine. He appreciates—possibly it would be well if his colleagues in practice also appreciated it—the very satisfactory results to be accomplished in prostatic cases by massage diligently and intelligently used over long periods of time. Without taking too hostile an attitude to Dr. Overall's generally safe and conservative position, we would, however, say that, if the question became a personal one, the knife would fill us with less horror than the prospect of having a prostate "hammered at" (the expression is his own) "through rectum and urethra until the indurated tissue begins to soften, then atrophy."

Ueber die Bedeutung der funktionellen Nervenkrankheiten für die Diagnostik und Therapie in der Gynäkologie. Von Professor B. Krönig (*Leipzig: Erlangen. Verlag v. Georg Thieme, 1902.*)

Krönig has limited himself entirely to functional nervous diseases which he includes under neurasthenia, hysteria and hypochondriasis. He calls attention to the fact that although the ancient view that the pelvic organs were entirely responsible for the development of hysteria and neurasthenia has been abandoned, yet we cannot deny that they bear a very intimate relation to the functional nervous diseases. This view is held by both neurologists and gynecologists.

In Part I, under the heading "Diseases of the genital tract secondary to a primary mental disturbance," he includes: 1. Sudden cessation of menstruation due to fright. 2. Sudden starting of the flow due to fright. 3. The so-called nervous or phantom pregnancy occurring after a single cohabitation.

The author says: "Die Hysterie nimmt gern die Larve einer Organerkrankung an." As an example of this it is pointed out that hysterical or neurasthenic patients often present symptoms identical with those due to inflammation of the uterus and appendages. In other words, they resemble them identically, although on pelvic examination no abnormality can be detected. He also draws attention to the pain in the left ovarian region so common in hysterical or neurasthenic individuals—"Charcot's ovarian hysteria." These patients have often consulted many physicians previously and come with a diagnosis of inflammation of the ovary. Krönig agrees with Lomer that such cases of ovarian neuralgia are to be classed under hysteria and that this ovarian pain is due to a central disturbance.

He speaks especially of hysteralgia of the vaginal portion of the cervix, the pain also involving the vaginal vault, the mere touching of the parts giving rise to violent hysterical attacks.

Endometritis dolorosa (hyperesthesia of the endometrium) he considers one of the signs of hysteria. Vaginismus, according to Krönig, is a symptom-complex. It may return after confinement, after resecting the hymen or splitting the constrictor muscle, may still persist with a relaxed outlet and on the whole yields a very poor prognosis.

The author says that great care must be exercised to exclude organic lesions before rendering a diagnosis of hysteria in these cases. He draws attention to the fact that under ordinary circumstances the cervix and a large portion of the vagina can be removed, the patient complaining of very little pain.

Krönig describes in detail those nervous cases where there is much tenderness over the lower abdomen and the patient feels that "everything is dropping out" and yet on examination no lesions exist. He also points out that many patients fall into the hands of the gynecologist instead of the neurologist. Consequently on the former rests the responsibility of deciding whether the backache and pelvic pain are due to disturbances of the sexual organs or whether they be secondary to a general neurosis. A thorough examination of the entire nervous system is necessary.

Under vaso-motor trophic disturbances with normal pelvic structures, long cessation of the period and painful profuse menstruation are considered. Krönig says that the nervous character of such menorrhagia and metrorrhagia is shown in the fact that local treatment is often ineffectual while a general building up yields the looked-for improvement. Reports are given where from fright the menses ceased permanently. Krönig thinks that many cases of dysmenorrhea have a purely hysterical basis.

The second portion of the book is given up to treatment of these cases. We note with much pleasure that in so-called erosions, lacerations of the cervix, misplacements of the uterus and cases of "small cystic ovaries" he advocates building up the patient first, in the hope that no operation may be necessary. By isolation of the patient in a hospital, suitable diet, massage, exercise of various kinds and particular attention to the patient's mental impressions he has in many cases obtained excellent results without any treatment of the local condition. It is gratifying to note that the treatment outlined is based on that outlined by one of our most distinguished countrymen, Dr. Weir Mitchell, of Philadelphia. Krönig describes it in detail and expresses in the highest terms its value in many cases. In a goodly number of cases it is of course necessary to combine an operative procedure with the rest treatment.

Rarely has the reviewer undertaken the perusal of a medical book with greater reluctance. First he feared that the many contradictory symptoms in this class of cases gave little hope of an elucidation of the subject, and second, he knew that the group of patients which try the ingenuity of the physician almost beyond endurance is composed of those who suffer from supposed functional nervous phenomena attributable to the pelvic organs. The work under consideration has been written by a man peculiarly fitted for the task, thoroughly grounded in pathology and bacteriology and with a large clinical experience. We had reason to expect a well-rounded, clear and unbiased consideration of the subject and have not been disappointed. It is high time that many members of the profession appreciate that the distressing train of nervous symptoms referable to the pelvis are not often due to the so-called cervical erosions or to slight lacerations of the cervix and that the perfunctory local applications to the cervix for supposed "ulceration of the neck of the womb" or the repair of slight lacerations of the cervix be abandoned and the Weir Mitchell treatment or a modification of the same be adopted.

The work of Krönig is a most timely one. It embraces not only his own experience, but also gives a complete *résumé* of the subject. Not only should it be read by the gynecologist, but also by every physician. Thus many women who would otherwise come under the gynecologist's care can be satisfactorily relieved without the necessity of calling in the aid of the specialist, or will come under his care only as a last resort.

The Practice of Medicine. A text-book for practitioners and students. By James Tyson, M. D., Professor of Medicine in the University of Pennsylvania, and Physician to the Hospital of the University. Third edition, thoroughly revised. With 134 illustrations, including colored plates. (*Philadelphia: P. Blackiston's Son & Co., 1903.*)

Appreciative reviews of the two previous editions of this work have appeared in the pages of this journal. The present third edition does not tend to lessen the high regard in which this book has been held by all familiar with it, but rather to increase our

conviction of its excellence. It has become one of the standard text-books in medicine used by English-speaking students, and quite justly so.

In the present edition numerous small changes and additions have been made, without, however, increasing the size of the book or modifying to any extent its general plan. As probably our knowledge of the infectious diseases has undergone the most rapid change during the past few years, so the greatest number of changes are to be expected and are to be found in this section. The excellent chapter on typhoid fever was commented on in the review of the first edition. Among the additions to this chapter it is unfortunate that the author has failed to mention the marked effect of the typhoid poison on the blood-vessels, to which a number of observers, especially the French, have lately drawn attention. This is also omitted in the discussion of arterio-sclerosis; in fact, none of the acute infections are mentioned as playing any rôle in the production of this condition. Also, no mention is made of the diagnostic importance of the isolation of the typhoid bacillus from the blood, urine and fæces. These procedures, cultures from the blood at least, in hospitals, or even in private practice, do not offer very great difficulties, and in many cases are of great value in early diagnosis.

That the chapter on dysentery has been reviewed by such an authority as Dr. Flexner is in itself proof that the very latest ideas in regard to this condition are presented.

We think that most of those who have had large experience with diphtheria do not quite agree with the author in their treatment of this disease. The present tendency is to give very large doses of anti-toxine, many insisting that from 7000 to 10,000 units should be given at the outset, even to cases of moderate severity. Undoubtedly many practitioners have been employing too small amounts. This, however, is a somewhat debatable point.

In the diagnosis of the various forms of meningitis (aside from cerebro-spinal fever) we do not think the author has laid sufficient emphasis on the value of lumbar puncture—under the diagnosis of tuberculous meningitis it is not even mentioned. The statement made in the chapter on cerebro-spinal fever that in tuberculous meningitis the fluid obtained by lumbar puncture is clear, requires some modification.

These criticisms, however, most of them directed toward small errors of omission, are simply similar to those which might be presented in regard to any book of so comprehensive a character as this. The remarkable feature of the book is that it contains so much, not that something has been omitted.

As in the second edition, the chapter on nervous diseases has been revised by Dr. Spiller, and both in arrangement and matter the standard of the remainder of the book is maintained.

It is a great pleasure to review such an excellent text-book, which presents to the students so clearly a summary of our knowledge of disease.

Clinical Treatises on the Pathology and Therapy of Disorders of Metabolism and Nutrition. Part IV. The Acid Antitoxins. By DR. CARL VON NOORDEN, Physician-in-Chief to the City Hospital, Frankfort-a.-M. (*New York: E. B. Treat & Co., 1903.*)

This little book is disappointing. Instead of a general discussion of the subject the author has limited himself quite strictly to his own ideas of diabetes.

A Pocket Book of Clinical Methods. By CHAS. H. MELLAND, M. D., Lond., M. R C. P., Physician to the Ancoats Hospital, Manchester. (*Bristol: John Wright & Co.; London: Simpkin, Marshall, Hamilton, Kent & Co., Ltd., 1903.*)

This little book was certainly intended for the pocket. It is small, the pages number but seventy-five, with a few additional blank pages for memoranda. A few clinical methods are briefly described. The author seems to think that few are valuable. We cannot agree with him concerning his tests for free HCl in gastric contents, because of the slight value he places upon fresh blood examinations, as well as the orthography of eosinophil, neutrophil, etc.

The book has little value and is a source of danger to the student who is inclined to be lazy.

Surgical Anatomy and Operative Surgery. For Students and Practitioners. By JOHN J. MCGRATH, M. D., Professor of Surgical Anatomy and Operative Surgery at the New York Post-Graduate Medical School, Visiting Surgeon to the Harlem Hospital, etc. 559 pages, with 227 illustrations, including colors and half-tones. (*Philadelphia: F. A. Davis Co., 1902.*)

In the preface the author states that he has endeavored to combine in a practical manner the subjects of surgical anatomy and operative surgery, excluding as far as possible all anatomical considerations not of practical value in the performance of these operations. It is evident at a glance that the author of this volume has undertaken an almost impossible task when he attempts in this limited space to describe the operations of general surgery, even in a very condensed form, especially since more than two hundred of the pages are taken up with surgical anatomy and diagrams. Many of the descriptions are exceedingly concise but in several instances are considerably aided by the diagrammatic plates.

The book is divided into ten sections, the first being an unsatisfactory outline of anæsthesia, and a few general considerations. In the sections which follow, the surgical anatomy of each part is given, more or less at length, preceding the description of the operations, which for the most part are much too brief to be of use to one not thoroughly familiar with surgical procedure; for instance, the operations on the liver and gall bladder, including the surgical anatomy and diagrams, are given in eighteen pages.

Looking through the book we are struck by the omission of many important operations, among them thyroidectomy, for aneurysm, operations on the heart, for umbilical hernia, the high operation for varicocele, on the ureters, for osteomyelitis and others, both old and new.

Plastic operations on the face are considered quite fully, and most of the modern methods of intestinal anastomoses are taken up.

The usual ligatures, amputations and excisions are described briefly, but no mention is made of gynecological operations or those of the special branches.

There is as a rule no advice as to the operation of choice when two or more are described, and taking it all in all, the book is too incomplete for either students or practitioners to depend on entirely.

The American Year Book of Medicine and Surgery for 1904. Being a Yearly Digest of Scientific Progress and Authoritative Opinion in all branches of Medicine and Surgery, etc. Under the general editorial charge of George M. Gould, M. D. Medicine. (*W. B. Saunders & Co., 1904.*)

The volume for this year keeps up the usual standard of excellence. A new feature is a short summary for each department of the more noteworthy advances during the year. These are short and well done. There is no possibility of a minute review of a work such as this. We can only express our appreciation of its value and the excellent way in which it is prepared.

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